AN EXPLORATION OF YEAR 10 STUDENTS' MOTIVATION, ATTITUDE AND SELF-EFFICACY TOWARD LEARNING CHEMISTRY

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ANDREW ITA MISITOMU

KO TE TANGATA

THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

Centre for Science & Technology Education Research

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ABSTRACT

> How you see the world is largely a function of where you view it from, what you look at, what lens you use to help you see, what tools you use to clarify your image, what you reflect on and how you report your world to others. (Anderson, 2000, p. 3)

Chemistry education is a broad term that refers to the study of the teaching and learning of chemistry in all schools, colleges and universities. The need to understand student motivation, attitude, and self-efficacy toward learning chemistry, how best to teach and improve learning outcomes in chemistry are paramount. These needs could be met by changing teaching methods and appropriate training of chemistry instructors, within several modes, including classroom teaching, demonstrations, and laboratory activities. There is a constant need to update the skills of chemistry teachers, and in acquiring a better understanding of students' motivation, attitude, and self-efficacy toward learning chemistry; chemistry education speaks to this need.

This study explores students' motivation, attitude and self-efficacy toward learning chemistry. It uses Year 10 chemistry students in four secondary schools in Honiara, Solomon Islands as its study participants. Its primary objective is to examine student perceptions, and to investigate associations between chemistry students' motivation, attitude, and self-efficacy. The research adopts an interpretive approach to research, and employs a mixed methodological approach using questionnaire and semi-structured interview for data collection. It uses cross tabulation, thematic and statistical analysis for data presentation, analysis and theory formation.

The significant results of the study substantiate suggestions made by other research studies that student motivation, attitude and self-efficacy shape the behaviour of students toward learning chemistry. The nature of influence depends on the degree of success in prior student learning experiences.

This study finds that, student motivation as a personal construct is intrinsically driven. Thus motivated students have a positive attitude toward learning chemistry and do learn effectively while unmotivated students place less effort into the learning process. This study suggests students' attitude toward learning chemistry is shaped by past teaching and learning experiences, and the influence of parents and peers on students' normative beliefs. In addition, intrinsically motivated students acquire a sense of self-worth and confidence, setting achievable goals and working toward achieving them.

Such findings call for a contextualised chemical education for young people, driven by past changes in chemistry education in schools and the needs and interests of our young people, our future citizens. The need to develop learning and instructional materials that are holistically interwoven with the learners' socio-cultural context with prior and intended chemistry knowledge is a worthy call. This is important for worthwhile and lifelong learning. The country's socio-cultural context could therefore be embedded into the curriculum materials (syllabus, students' books, teachers' guides and learning resources). The socio-cultural application of chemical knowledge, skills and principles could, therefore, be the central focus in instructional and learning materials design. This could help increase student motivation; creates positive attitude change, and help boost student self-efficacy toward learning chemistry.

DEDICATION

This thesis is dedicated to my dearly loved Son
Andrew Junior Kemuel Misitomu (AJKM)

My dearest wife
Louise Abisato Siunaliko Kwanairara Misitomu

My father
Wilfred Misitomu Toifai

My mother
Hilda Mary Goulo Misitomu

For all your unreserved love, endless support with prayers and blessings

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ABBREVIATIONS

ANOVA	Analysis of Variance
AJKM	Andrew Junior Kemuel Misitomu
BSc	Bachelor of Science
C1 – C8	Classes 1 - 8
CDC	Curriculum Development Centre
CEA	Catholic Education Authority
CHS	Community High School
CLT	Cognitive Learning Theory
COM	Church of Melanesia
CSTER	Centre for Science and Technology Education Research
DTS	Diploma in Teaching Science
EA1 – EA4	Education Authorities 1 - 4
ECE	Early Childhood Education
ELM	Elaboration Likelihood Model
GDipTSc	Graduate Diploma in Teaching Science
LSL	Lave’s Situated Learning
MEHRD	Ministry of Education and Human Resources Development
MTPB	Modified Theory of Planned Behaviour
NPM	Natural and Processed Materials
NSS	National Secondary School
PS	Primary School

PSS	Provincial Secondary School
S1 - S4	School 1 – 4
SCT	Social Cognitive Theory
SDT	Social Development Theory
SET	Self-Efficacy Theory
SICHE	Solomon Islands College of Higher Education
SINSO	Solomon Islands National Statistical Office
SINSC	Solomon Island National Science Curriculum
SLT	Social Learning Theory
SMASEC	Student Motivation, Attitude and Self-Efficacy toward learning Chemistry
SOE	School of Education
SSEC	South Seas Evangelical Church
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
USP	University of the South Pacific

CHAPTER 1: INTRODUCTION TO THE STUDY

1.1 Introduction

This chapter provides an introduction and overview for the study. This study explores Year 10 students' motivation, attitude and self-efficacy toward learning chemistry. The chapter begins with the study overview and background. The statement of the issue at hand and the significance of the study are presented, followed by the study context, the research purpose, objectives and questions. A discussion of the research methodological overview will be covered next, concluded by an overview of the thesis.

1.2 Study Overview and Background

This study has focussed on Year 10 chemistry students in Solomon Islands secondary schools. It investigated students' motivation, in terms of their views on the value of chemistry learning, students' performance goals, and academic achievement. It also investigated students' attitude toward chemistry and their self-efficacy toward learning chemistry.

Research suggests that students' attitude is determined by their desire to achieve (Hong & Lin, 2011; Reid, 2007). Some authors argue that it is, in fact, that achievement that determines students' attitudes, and that values toward science are important outcomes in science education (George & Kaplan, 1998; Jovanovic & King, 1998; Osborne & Collins, 2000; Simpson & Oliver, 1990). Values related to science have a clearly recognizable influence on participation in the study of science and in the choice of career. In the same way, students' attitudes also influence both achievement and participation in science (George & Kaplan, 1998; Keeves & Alagumalai, 1998).

The literature also suggests that self-efficacy beliefs determine one's functioning as a human being in that people's level of motivation, affective status, and actions are based more on what they believe than on what is objectively true (Bandura, 1977). It can also be said that self-efficacy has a significant bearing on one's ability to acquire knowledge and utilize it effectively (Bandura, 1997). It is of interest to note that if one's level of self-efficacy can determine career path, then that selected career may in fact shape one's life choices based purely on one's level of perceived self-efficacy at a particular point in time. This implies that it is important that students are given the opportunities to develop their cognitive skills, in order to develop high levels of self-efficacy (Bandura, 1986).

1.3 Statement of Issue

Over my years of teaching science, I have had numerous encounters in which the capability of students to pursue further studies in chemistry declines as they move through the formal education system. The ability to build a firm belief in students (motivation) to overcome their fear of failing (change of attitude) in studying chemistry sparks an interest in me. According to the conviction that one can successfully execute the behaviour required to produce an outcome, self-efficacy is an important precondition for behavioural change, since it determines the initiation of coping behaviour (Bandura, 1986). Thus, it is of interest to pose questions to gather information about the nature of students' motivation, attitude, and self-efficacy toward learning chemistry.

1.4 Significance of Study

This research study is significant for the following reasons. First and foremost, there have been few studies conducted on students' motivation, attitude and self-efficacy toward learning chemistry in third world or developing countries. Therefore, information gathered from this research will provide an additional source of information that can contribute to the literature on students' motivation, attitude and self-efficacy toward learning chemistry within the Melanesian context of the Pacific.

Secondly, this research study is significant as the information gathered can help curriculum developers in Solomon Islands through the Ministry of Education, Curriculum Development Centre (CDC), and to other similar bodies within developing countries, in the planning and designing of appropriate learning strategies to address issues in chemistry teaching and learning in secondary schools. This will be important in the Solomon Islands in the light of the current review of the science syllabus which begun in 2003 (Ministry of Education and Human Resources Development [MEHRD], 2004).

This study is also significant as the views and experiences of student participants can be compared to other related studies that have highlighted the significance that students' attitudes play in determining active learning and enjoyment of chemistry lessons. All students have the potential to learn, and it is important to provide a variety of learning experiences and an environment that promotes positive attitudes in classroom learning. It is widely agreed that students learn differently (Cook, 1997; Morrel & Lederman, 1998). The ability to know and identify student types can assist teachers in developing more relevant activities geared towards better acquisition of knowledge and thus increase learning (Briggs & McCulley, 1993; Cook, 1997).

In summary, this research project is significant because the area of science education research is new in third world countries like Solomon Islands and its neighbouring Pacific Island nations. Therefore, this study provides an opportunity to hear student stories about their motivation, attitude and self-efficacy toward learning chemistry.

1.5 Study Context

Solomon Islands is a sovereign state in Oceania, east of Papua New Guinea, consisting of nearly one thousand islands. It covers a land mass of 28,400 square kilometres (ca. 11,000 sq mi). The capital, Honiara, is located on the island of Guadalcanal. The nation of the Solomon Islands is a member of the Commonwealth of Nations with an estimated population of 533,672 and an annual population growth rate of 2.3% (Solomon Islands National Statistical Office (SINSO), 2006). There are various ethnic groupings within Solomon Islands with Melanesians the dominant group, comprising 94.5 percent of the population (Maelagi, 2011; Phillips & Owen, 1994). The second largest group are Polynesians (3%), followed by Micronesians (1.2%) with Asians, Europeans and other ethnicities including other Pacific Islanders, Africans and others making up the rest (1.3%).

1.5.1 History

The Solomon Islands are believed to have been inhabited for many thousands of years. Spanish navigator Álvaro de Mendaña was the first European to arrive in Solomon Islands in 1568 coming from Peru and named them - *Islas Salomón*. Many of the islands in the Solomon Islands bear Spanish names because of Mendana’s Spanish heritage (Honan & Harcombe, 1997; Kaikai, 2010; Sade, 2009). In 1893, the United Kingdom established a protectorate over the Solomon Islands. In 1976, self-government was obtained, which led to independence two years later on 7 July, 1978. The National Constitution was adapted from the Westminster democratic government system. The British monarch - Queen Elizabeth II, as the head of state is represented by the Solomon Islands Governor General (Honan & Harcombe, 1997).

1.5.2 Geography

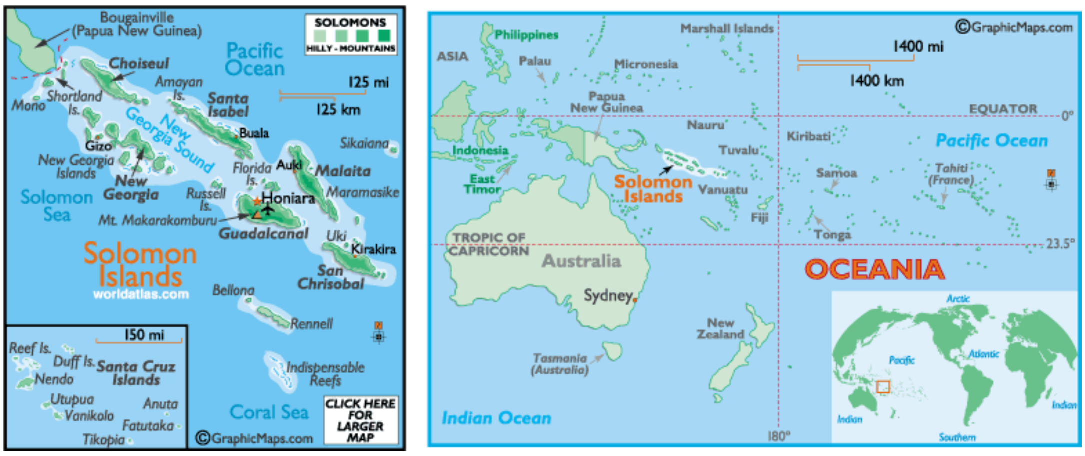

Figure 1.1. Map of Solomon Islands in relation to the Oceania region (see insert). Retrieved from http://www.worldatlas.com/webimage/countrys/oceania

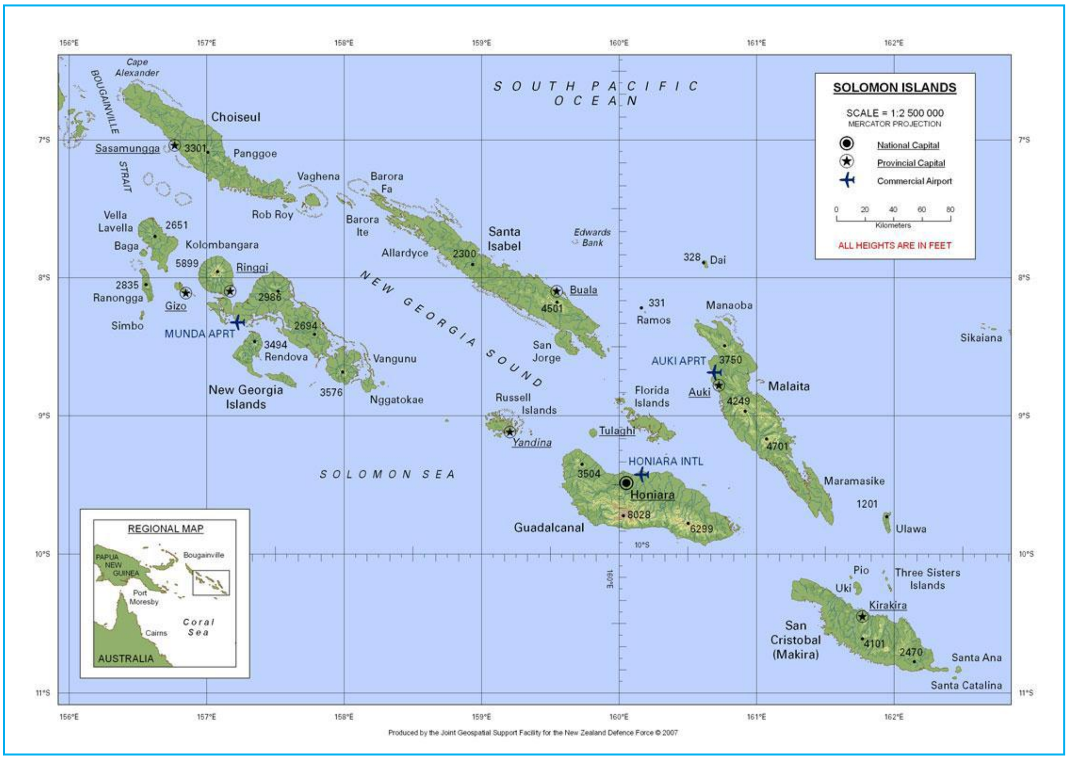

Figure 1.2 Map of Solomon Islands showing its location respective to Australia (see insert). Retrieved from http://www.army.mil.nz

The Solomon Islands is located among other Melanesian island nations within the South Pacific region. The Solomon Islands consists of six major islands and approximately 992 smaller islands, atolls and reefs, stretching over approximately 1,500 square kilometres, with land area of some 28,400 square kilometres. The climate is maritime tropical with heavy rainfall and an average temperature of 27°c and periodic maritime cyclones (Honan & Harcombe, 1997; Sade, 2009).

1.5.3 Education in Solomon Islands

Education in the Solomon Islands is governed by the 1978 Education Act and is patterned after the British system. The law, however, does not make education compulsory at even primary level, which is the main reason only 60 percent of school-age children have access to the six-year (Year 1-6) elementary or primary education, the first level of the three-tier system of education in the country. The second level is the seven-year secondary school (Years 7 – 13) which consists of the government's provincial, national and community secondary schools and several privately run high schools. The third level is the tertiary level, which consists of higher education and university studies.

The MEHRD has made the education system heavily examination-based, especially after the primary and secondary levels, with the intention to improve quality of education and literacy among the students. It is also implementing programs that will help do away with the problems that hinder provision of educational facilities throughout the country such as isolation of communities from urban centers, poor national mailing system, and lack of telecommunications especially in remote rural areas (MEHRD, 2005).

There are five types of schools operating in the formal education system of the Solomon Islands: Early Childhood Education Centres (ECEs), Primary Schools (PS), Community High Schools (CHS), Provincial Secondary Schools (PSS) and National Secondary Schools (NSS). Early Childhood Education (ECE) centres are the first introduction to formal schooling for most Solomon Islanders. ECE centres, also known as Kindergartens, tend to be community or village-based. Currently, formal education commences in Primary schools at the preparatory grade, for children aged 6 years. Primary education in the Solomon Islands begins with the preparatory class, and goes up to Standard 6 (Year 6). The purpose of Primary education is to introduce children to the skills needed for writing, reading, mathematics, community studies, science, agriculture, art, music, physical education and Christian education. Secondary education follows Primary schooling and continues beginning from Form 1 (Year 7), and going through to Form 5 (Year 11), with some schools going through to Forms 6 (Year 12) and 7 (Year 13). The curriculum is such that at Years 7 – 11, chemistry is compulsory, meaning that students have no choice but to study it. In National Secondary Schools (NSS), chemistry is taught as a separate subject. In most community high schools, chemistry is taught within general science due to a lack of specialised chemistry subject teachers. The purpose of secondary education is to expand knowledge of subjects studied at primary school including literature, science, mathematics, social studies, commerce and other subjects essential for physical and intellectual development, and to prepare students for specialised skills training (Kaikai, 2010; MEHRD, 2005; Sade & Coll, 2003).

Successful completion of the second level qualifies students to enter the third level (tertiary) or higher education, which is provided by the Solomon Islands College of Higher Education (SICHE), and its seven schools, and the University of the South Pacific, Solomon Islands Centre (USP Centre) – all located in the nation’s capital city, Honiara. The USP Centre offers distance learning courses for high school students who have failed in the qualifying examinations given by the government through the Ministry of Education and Human Resource Development (MEHRD). Students who are eligible to pursue degree studies can pursue their studies at the centre.

1.6 Research Purpose and Objectives

The aim of this research is to investigate Year 10 students’ motivation, attitude and self-efficacy (i.e., students’ perception of their ability to do a specific task) toward learning chemistry. This can then be used to help understand the nature of learners in chemistry learning environments. The intention is to provide insights into alternative ways of teaching and learning that might motivate, change students’ attitude, and increase students’ self-efficacy toward learning chemistry.

The basic objectives for the research derived from the broad aims and objectives are:

- To identify Year 10 students self-perception of:
    - Their motivation, attitude, and self-efficacy toward learning chemistry; and
- To qualitatively investigate associations between:
    - Students’ motivation and their attitude toward learning chemistry; and
    - Students’ motivation, attitude, and self-efficacy toward learning chemistry

It is hoped that the findings of this study can be used to make improvements towards rethinking, reordering and implementing teaching and learning strategies that would promote effective student motivation, attitude and self-efficacy toward learning chemistry in secondary schools.

With this purpose, this research was conducted to answer the following research questions:

1. What motivates students to study chemistry?
2. What inhibits student motivation toward studying chemistry?
3. What are student attitudes toward studying chemistry?
4. What is student self-efficacy toward studying chemistry?
5. What association, if any, is there between student motivation and their attitude toward learning chemistry?
6. What association, if any, is there between student motivation, attitude and self-efficacy toward learning chemistry?

1.7 Methodology Overview

For this research, a mixed method research approach was used. The methods used were a survey, using the Student Motivation, Attitude and Self-Efficacy toward Learning Chemistry (SMASEC) questionnaire comprising 32 items, and semi-structured focus group interviews (Appendices E & F). The choice of survey as a research tool lies in its appeal to infer generalizations within given parameters, its ability to make statements which are supported by large data banks and its ability to establish the degree of confidence which can be placed on a set of findings are reasons for its choice (Cohen, Manion, & Morrison, 2007; Johnson & Onwuegbuzie, 2004; Onwuegbuzie & Leech, 2010).

The self-completion SMASEC questionnaire used in this study was administered in four different schools with eight different Year 10 classes. The sample size was 258, and the students were between 14 and 15 years of age. The SMASEC questionnaire was developed specifically for this study and was piloted and validated for use in the Solomon Islands. Students responded to each of the items using a five-point Likert scale (Appendix E). This method is chosen based on its ability to build in a degree of sensitivity and differentiation of responses while still generating numbers (Cohen et al., 2007).

The quantitative data were analysed and are described in detail in Chapter 4, along with the qualitative data. The qualitative data were obtained by conducting a focus group interview for each of the eight classes surveyed. The intention was to obtain an in-depth interpretation of patterns established from the quantitative data. Such an approach allows for exact voice of interviewees to be extracted, and gives the research greater reliability by providing deeper understanding of students' perceptions of their chemistry classroom environment.

1.8 Chapter Overview and Thesis Organization

This study seeks to provide evidence of a good chemistry classroom environment and its students, and their motivation, attitude and self-efficacy toward learning chemistry. This chapter (Chapter 1) describes the context of the study as well as providing relevant background information. It also presents a brief overview of the methodology and explains the significance of this particular research in chemical education.

Chapter 2 provides an extensive literature review, which is related to the theoretical basis for the study. Here, the relevant investigations and previous research studies using other instruments are described. The theories that are related to students' motivation, attitude and self-efficacy in science and chemistry are presented here. Relevant literature here consists of the theories of learning and motivation, self-efficacy, students' attitude toward learning science and motivation and learning in general.

Chapter 3 details the methodology adopted in this study. It begins with an overview of what educational research is, followed by a discussion of research paradigms. The rationale for the choice of paradigm is then provided followed by the research instrument selection, and development, the surveyed population, and sample size. Concluding the chapter is the data generation and data collection procedures, along with the data analysis schemes used in this study.

Chapter 4 presents the findings from both the SMASEC quantitative and qualitative data, including statistical analysis. These data are used to validate the SMASEC instrument used in the study. Further analysis of student motivation, attitude and self-efficacy toward learning chemistry are then detailed. The quantitative and qualitative data are summaries followed by the interpretation of the quantitative and qualitative data.

Chapter 5 provides a discussion of the research findings presented in Chapter 4 in terms of relevant literature, drawing some conclusions from the findings. This chapter begins with a discussion of the research findings for each of the six research questions. Following from this are the implications based upon the conclusions from this research. Next is a discussion on the limitations of the research, followed by some recommendations for future research. This chapter ends with some concluding thoughts.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter provides an overview and theoretical background for this thesis. Topics covered include student motivation, attitude and self-efficacy toward learning science and chemistry. Relevant literature here consists of the theories of learning and motivation, self-efficacy, student attitude toward learning science, and motivation and learning generally. Student motivation to learn as noted earlier is influenced by their perceptions of, and behaviour toward, the subject and the learning environment. Issues of this nature have been explored in the literature by a number of authors (Bandura, 1986; Britner & Pajares, 2006; Usher & Pajares, 2006), and examination of the literature suggests that expectations such as motivation, performance, and feelings of frustration associated with repeated failures, determine and affect behavioral reactions and this results in either motivating or de-motivating student toward science learning (Bandura, 1986). Each of these is now discussed in turn.

2.2 Theories of Learning and Motivation

Under this section, constructivism, social learning theory, social cognitive theory, theories of motivation, the theory of plan behaviour, and the modified theory of planned behaviour are discussed. Motivation plays a very important role in engaging students towards achieving set goals (Ames, 1992; Dweck & Leggett, 1988). This is further associated with the concept of learning as a social interaction (Bandura & Locke, 2003). How confident students feel about doing things and their self-efficacy contributes greatly toward their motivation to learn. Each of these will be discussed next.

2.2.1 Constructivism

Constructivists believe that learning is an active, contextualized process of constructing knowledge rather than acquiring it (Barkin, 2003; Cobern, 1993; Fox, 2001; Sesen & Tarhan, 2010). With this view, knowledge is constructed through personal experiences and how the learner relates to the environment. Learners, therefore, on a continual basis test their hypotheses via social negotiation. Each individual has a different way of interpreting and constructing knowledge. The learner is not a blank slate (*tabula rasa*), but brings experiences and cultural factors to a learning situation. A common misunderstanding regarding constructivism is that instructors should never tell students anything directly but, instead, should always allow them to construct knowledge for themselves. This is actually confusing a theory of pedagogy (teaching) with a theory of knowing. At the centre of constructivism lies the assumption that all construction of knowledge is obtained from the learner's previous knowledge, regardless of how one is taught. Thus, even listening to a lecture involves active attempts to construct new knowledge (Raina, 2011; Sesen & Tarhan, 2010).

Constructivism theory is about how we learn and the thinking process, rather than about how students memorize and recite a quantity of information. From Vygotsky's (1978) perspective, learners construct meaning from contextual reality and do not passively receive what they are taught in their learning environment. Therefore, for the constructivist, learning involves constructing, creating, inventing, and developing one's own contextual knowledge and meaning. The teacher's role, therefore, is one of facilitating and providing information, and organizing activities for learners to discover their own learning. Learning in the constructive classroom was also described by Cobern (1993) and Raina (2011) as the cycle of questioning, interpreting, analyzing information, and combining information and thinking to develop, build and alter meaning and understanding of concepts, and integrating new understandings with past experiences. In a constructivist classroom, learners do not passively repeat the information delivered from teachers. They demonstrate their learning and understanding through different means, such as developing critical questions (Barkin, 2003;

Cobern, 1993), and applying the knowledge acqiuired to real life situations (Fox, 2001; Sesen & Tarhan, 2010).

While constructivism is a means of developing learners' understanding of concepts and the joining in of new understanding, critics say that it does not really account for the cognitive learning interactions whereby learners' understanding operates and performs. This aspect is covered next.

2.2.2 Social Cognitive Theory (SCT)

According to Bandura (1986), the Social Cognitive Theory (SCT) takes into account the interactions whereby the cause of behaviour operates and therefore is displayed. Happenings within the environment, individual characteristics and factors and behaviour are part of each other, and of the big picture. An observed behaviour is, therefore, determined by these factors interacting with each other. Social cognitive theory explains how people acquire and maintain certain behavioural patterns, while also providing the basis for intervention strategies (Bandura, 1997, 2002; Walker & Greene, 2009). To evaluate behaviour change, the environment, people and behaviour should all be considered. Environment, according to Parraga (1990), refers to the factors that can affect a person's behaviour. There are social and physical environments. The social environment includes family members, friends and colleagues, while the physical environment includes the size of a room, the ambient temperature or the availability of certain foods and refreshments. According to Parraga, the environment and its situation provide the frame and basis for understanding behaviour. The situation refers to the cognitive or mental representations of the environment that may affect a person's behaviour. For example, according to Tollefson (2000), children enter schools with thoughts about the task of discovering what it takes to be successful in the school environment. Based upon the judgments students make about the personal characteristics that are necessary for success in school, children begin to develop in their minds theories about whether they can be successful in school. Once the theories are developed, students' classroom behaviour reflects their personal theories about the variables that produce success or failure in school. The link between attribution and behaviour is both delicate and complex (Cooper & Good, 1983), and researchers have studied such link in controlled settings (Ames, 1984; Nicholls, 1975) and in classroom settings. School-based research suggests that students who expect to do well in school earn higher grades than students with similar ability who expect to fail (Battle, 1966; Eccles, 1983; Tollefson, 2000). The situation is a person's perception of the environment, time, physical features and activity (Bussey & Bandura, 1999; Glanz, Rimer, & Lewis, 2002).

The three factors, environment, people and behaviour constantly influence each other. Behaviour is not simply the result of the environment and the person. Similarly, the environment is not simply the result of the person and behaviour (Bussey & Bandura, 1999; Glanz et al., 2002). The environment provides models for behaviour. Learning by observation occurs when a person watches the actions of another person and the reinforcements that the person receives (Bandura, 1997). The concept of behaviour can be viewed in many ways. Behavioral capability, according to Bandura (1997), means that to perform behaviour, a person must know what the behaviour is and have the skills to perform it.

In conclusion, Social Cognitive Theory (SCT) maybe helpful for understanding and predicting behaviour and identifying methods in which behaviour can be modified or changed. It, however, does not clearly cover the social aspect of learning that is taking place in the learning environment. This aspect of social learning is covered next.

2.2.3 Social Learning Theory (SLT)

The Social Learning Theory (SLT) has sometimes been called a bridge between behaviourist and cognitive learning theories because it encompasses attention, memory, and motivation (Bandura, 1977, 1986; Schunk, 1995). The theory is related to Vygotsky's Social Development Theory (SDT) and Lave's Situated Learning (LSL), which also emphasize the importance of social learning.

According to the SLT literature, people learn through observing others' behaviour, attitudes, and outcomes of the behaviour (Bandura & Locke, 2003; Bandura & Walters, 1963; Schunk, 1995). Most human behavior is learned through observation and modelling: from observing others, one forms an idea of how new behaviours are performed. This coded information is stored for later occasions to serve as a guide for action (Bandura, 1977, 1986; Bandura & Locke, 2003; Schunk, 1995). Social learning theory thus explains human behaviour in terms of its continuous and interchangeable interaction between cognitive, behavioural, and environmental influences.

Necessary conditions for effective modelling, according to Bandura (1977, 1986), consist of attention, retention, reproduction and motivation:

1. Attention — various factors increase or decrease the amount of attention paid. This includes distinctiveness, attractiveness, occurrence, complexity, and functional value. One's characteristics (e.g., sensory capacities, arousal level, and inferences, interpretations, past reinforcement) affect attention;
2. Retention — remembering what you paid attention to. This includes how one assembles language using symbols, mental images, cognitive organization, symbolic rehearsal, and motor rehearsal;
3. Reproduction — reproducing the image, including physical capabilities, and self-observation of reproduction; and
4. Motivation — having a good reason to imitate others includes motives such as past (i.e. traditional behaviourism), promised (imagined incentives) and vicarious (seeing and recalling the reinforced model) experience.

Bandura believed that every cause is a reproduction of behaviour, that is, the world and a person's behaviour replicate each other. Behaviourism essentially states that an individual's environment causes their behaviour. Bandura, who was studying adolescent aggression, viewed this idea as too simple, and said that behaviour also causes environment. Later, Bandura considered personality as an interaction between three components: the environment, behaviour, and psychological processes (a person's ability to entertain images in minds and language) (Bandura, 1977, 1986; Bandura & Walters, 1963; Schunk, 1995).

The SLT places more emphasis on learning that is acquired through observation. By observing expert's behaviour, attitude and behavioural outcomes, a learner can learn the desired behaviour. With continual and interchangeable interaction, the behavioural outcome can be performed by the learner. Such changes and modification of behaviour thus promote motivation. The theories of motivation are discussed next.

2.2.4 Theories of Motivation

Motivation is an important factor in attaining goals. Ames (1992) and Dweck and Leggett (1988) say that students that are motivated learn more effectively, while unmotivated students are likely to cause disturbances in the classroom. There is also a clear distinction between performance and learning goals. Students with performance goals focus on their ability and their sense of self-worth. These students strive to attain higher grades, and students who are genuinely interested in acquiring a firm understanding of knowledge to be learned are said to be pursuing learning goals (Ames, 1992; Covington, 1984; Dweck & Ellen, 1988; Gage & Berliner, 1979; Martin, 2003). Weiner (1990), in relation to students' preferences and their responses to different motivating actions, identified four major motivational patterns: (1) students' need to achieve, (2) intrinsic curiosity to obtain knowledge, (3) students' feeling of responsibility, and (4) students' involvement in social interactions. Weiner made a distinction between physiological and psychological motivations. He said that the latter includes three types of motivations: curiosity (the tendency to be aroused by the external environment); achievement (the completion of a task that is meaningful to the individual); and affiliation (a search for satisfaction through interacting with others).

With the application of a process model of motivation to academic achievement, students perceived that social context (e.g., family support, school environment, neighbourhood characteristics) directly influences their self-system (e.g., perceived autonomy, relatedness, and competence), which in turn leads to students' action (cognitive, behavioural, and affective indices of engagement/disengagement in learning) (Connell, 1990; Martin, 2003). In addition, student engagement or action behaviour directly impact academic outcomes such as grades and aptitude test scores. Such an act of engagement appears to be the basis of academic achievement motivation. Several studies have provided empirical support for this process model of motivation (Connell, 1990; Connell & Spencer, 1994; Connell & Wellborn, 1991; Tucker, Caraway, Reinke, & Hall, 2003).

Student engagement as a basis to academic achievement motivation plays a vital role in the planning of behaviour. Thus, students' academic motivation lies in the way students view, plan and intend to perform such behaviour. The basis for such a drive from intentions to action will be discussed next under the Theory of Planned Behaviour.

2.2.5 Theory of Planned Behaviour (TPB)

The Theory of Planned Behaviour (TPB) was proposed by Icek Ajzen in 1989 through his article "From intentions to actions: A theory of planned behaviour." The theory was developed from the Theory of Reasoned Action (TRA), which in turn was proposed by Ajzen and Fishbein in 1980, and which was grounded in various theories of attitude such as learning theories, expectancy–value theories, consistency theories, and attribution theory. According to the TRA, when a suggested behaviour is evaluated and seen as positive (attitude), and when such behaviour is seen as significant by others who want such behaviour to be performed (subjective norm), this results in a higher intention (motivation) and an individual is more likely to engage in such behaviour. A high correlation of attitudes and subjective norms to behavioural intention, and subsequently to behaviour, has been reported in many studies (e.g., Ajzen, 1989; Ajzen & Fishbein, 1980; Dalgety, 2003).

A counterargument to the high relationship between behavioural intention and actual behaviour has also been proposed by some authors (Ajzen, 1989; Ajzen & Fishbein, 1980). The results of these studies suggest that behavioural intention does not always lead to actual behaviour due to circumstantial limitations. That is, since behavioural intention cannot be a restricted cause of behaviour, an individual's control over the behaviour is partial. As a consequence, Ajzen (1989) introduced the theory of planned behaviour, with the addition of a new component "perceived behavioural control." By this, the theory of reasoned action is extended to cover non-volitional behaviours (i.e., ability to decide something by oneself and to take action to get what one wants) for predicting behavioural intention and actual behaviour (Ajzen, 1989; Ajzen & Fishbein, 1980). In addition to attitudes and subjective norms (which make the theory of reasoned action), the concept of ‘perceived behavioural control’, which originates from self-efficacy theory (SET) was added to the TPB. Self-efficacy, which was proposed by Bandura in 1977, had its origin in social cognitive theory. According to Bandura, expectations such as motivation, performance, and feelings of frustration associated with repeated failures determine and affect behavioural reactions.

Previous work suggests that peoples' behaviour is strongly influenced by the confidence they have in their ability to perform that behaviour (Bandura, 1977; Britner & Pajares, 2006). As SET contributes to explaining various relationships between beliefs, attitudes, intentions, and behaviour, it has widely been applied in health-related fields such as physical activity and mental health in preadolescents, and exercise as well as in chemistry education (Ajzen, 1989; Ajzen & Fisbein, 1980; Dalgety, 2003). As reported by literature, even though the TPB has been used at length in science education research, it has limitations. For instance, the TPB does not clearly categorise the antecedents or potential antecedents of attitude towards behaviour and subjective norm. The TPB with its consideration of various social and contextual based factors and its relations to intention and subsequent behaviour, however, suits constructivist and social constructivist based studies. On the other hand, the TPB is limited to answering the research questions regarding students' learning experience and self-efficacy (Ajzen, 1989; Ajzen & Fisbein, 1980; Dalgety, 2003).

2.2.6 Modified Theory of Planned Behaviour (MTPB)

A modified theory of planned behaviour (MTPB), as reported by Dalgety (2003), focuses on behaviour viewed as either a single action, or as a behavioural category. Single actions, according to Dalgety, include behaviours that singularly aim at acts such as listening to a lecture, whereas behavioural categories are a collection of single actions such as listening to a lecture, making notes, and so on. The view that attitude follows behaviour (Shrigley, 1990) similarly assumes that by observing behaviour, the knowledge of an individual’s attitudes can be learnt. Perceived behavioural control, according to Dalgety, is defined as an individual’s perception of the ease or difficulty of performing the behaviour of the given task. As such, perceived behavioural control is determined by the person’s control beliefs (a person’s beliefs about control over their own behaviour). Dalgety reported that chemistry self-efficacy is proposed to be an antecedent of perceived behaviour control in that if a student perceives that he/she does not have the ability to meet the desired behaviour he/she will avoid performing the desired behaviour. At this point, it is important to stress that there is a difference between self-efficacy derived from control beliefs which are based on a perception of barrier to studying chemistry, and attitude beliefs which are based on students’ perception about chemistry (Dalgety, 2003; Gerhardt & Brown, 2006). Additionally, a student’s individual behaviour is determined by more than just attitude, it is affected by social influences which are termed subjective norm (Ajzen & Fishbein, 1980; Dalgety, 2003).

Peers, family, mentors and the media may influence student’s attitudes toward chemistry. Research by Dalgety and Coll (2004) suggested that the link between peer attitude and student attitude toward science is weak. At the primary and secondary levels, the literature suggests that the educational expectations of friends are not that important to attitude, and other studies conducted have revealed that middle school students with a positive attitude toward science commonly have friends with less positive attitudes (Dalgety & Coll, 2004; Ray, 1991a; Schibeci, 1989). However, to some extent at the secondary level, students choose a peer group that reinforces their own background and interests. In other words, students with a background in science are likely to form peer relationships with students who also have a science background (Dalgety & Coll, 2004; Gogolin & Swartz, 1992; Talton & Simpson, 1985). Hence, as students' relationships with their peers develop and become stronger, the student attitude toward science becomes similar to that of their peer group (Dalgety & Coll, 2004; Hassan, 2008). Although peers seem to exert much less influence on students’ science enrolment choices than parents (Kremer & Walberg, 1981), research suggests that peers' attitude toward science has some affect in particular circumstances. For example, Panizzon and Levins (1997) reported that in boarding school situations, peers become a substitute for families. Furthermore, females tend to be influenced more by friends than males, with girls responding more to the perceptions of older students (Dawson & O'Connor, 1991) mainly in single-sex educational institutions (Johnston & Selepeng, 2001). Such an influence of peer social pressure increases in the early secondary school years, climaxing in Year 9 (Jones, Porter, & Young, 1996; Jones & Young, 1995; Talton & Simpson, 1985). At later stages of their secondary schooling, students perceive their peers to be supportive generally (Dalgety & Coll, 2004; Panizzon & Levins, 1997).

The effect of parental support on students' achievement has been researched extensively (Dalgety & Coll, 2004; Schibeci, 1989; Vedder-Weiss & Fortus, 2011; Weihua & Williams, 2010). However, research into the influence of parental attitude toward science on student science attitude as well as science attitude and science behaviour is limited. According to Schibeci (1989), the home background is unrelated to student attitude. Other work suggests, however, that attitude can influence attitude toward science and secondary students' normative beliefs about studying science. For example, Woolnough (1994) and George and Kaplan (1998) report that by providing avenues such as science-based extracurricular activities, or involvement in a scientific industry, parents may influence students' beliefs. Literature, therefore, seems to indicate that the home environment of non-science majors provides little exposure to science or science-related activities (Gogolin & Swartz, 1992; Vedder-Weiss & Fortus, 2011), whereas family support and the home environment are influential in student attitude toward science at the secondary level (Dalgety & Coll, 2004; George & Kaplan, 1998; Vedder-Weiss & Fortus, 2011; Woolnough, 1994).

There are also other studies reported in literature of research into the mentors as role models and the influence of society on students' attitudes toward science (Vedder-Weiss & Fortus, 2011). The research reported is concerned with the influence teachers have on students' science behaviour, including the level of student participation in science classes (Koballa, 1988b). Teaching methodology and teacher behaviour impact on students' science behaviour as early as elementary school (Koballa, 1988b; Ray, 1991) and continue on through to the secondary school (Koballa, 1988a). It appears that female students respond better to female teachers, but interactional studies between female students and female scientists are less clear, with some research suggesting the impact is minimal (Koballa, 1988b) and other studies suggesting that female scientists have influenced subjective norms significantly (Javis & Pell, 2002). On the other hand, there have been reports in the literature which suggest that the public relies heavily on the media reports portraying science for information about science issues (Cross & Price, 1999; Fensham, 1999). With the lack of the public in possessing sufficient knowledge of science to evaluate scientific material presented to them, societal attitudes and opinions tend to conform to media representations – however inaccurate or ill-informed these portrayals may be (Thompson & Bucat, 2001). According to Schibeci (1986), scientists are seen by the community as dispassionate individuals' who seek after truth and often have unanswered objective opinions, and thus do not venture far beyond experimental observations. Such a perception presents scientists as individuals who do scientific work without any consideration for the repercussions of their endeavours on the society. Students' views are like those of the general populace, subjected to such media influence (Dalgety & Coll, 2004).

From the literature above, it seems that normative beliefs about science are far less researched than attitudinal beliefs, although students who are interested in science subjects typically have parents who are supportive of them and involved them in science extra-curricular activities. These students also move toward peer groups who have similar interests and are, therefore, supportive of their science interests. The importance of mentors in promoting student interest and positive attitude toward science is paramount, as is the media and its influence on an ill-informed society and, therefore, students. It seems reasonable to conclude that how confident students feel about doing things is a factor in their motivation for learning. This is covered next.

2.3 Student Motivation Toward Science and Chemistry

2.3.1 Defining Motivation

Motivation is the driving force by which humans achieve their goals. Motivation is said to be either intrinsic or extrinsic. The term is generally used for humans, but it can also be used to describe the causes for animal behaviour as well. According to various theories (Areepattamannil, Freeman, & Klinger, 2011; Bannier, 2010; Benton, 2010), motivation may be rooted in a basic need to lessen physical pain and maximize pleasure, or it may include specific needs such as eating and resting, or a desired object, goal state of being, ideal or it may be attributed to less-apparent reasons such as altruism, selfishness, morality or avoiding morality (Elliott, Hufton, Illushin, & Lauchlan, 2001). Increasing the motivation of students to learn science both intrinsically and extrinsically is at the heart of major reforms in science education (Areepattamannil et al., 2011; Council, 1996, 2000). Intrinsic motivation here refers to behaviours performed out of interest and enjoyment (Ryan & Deci, 2000). In contrast, extrinsic motivation refers to behaviours carried out to attain possible outcomes (Ryan & Deci, 2000). Learning science for its own sake, for example, involves intrinsic motivation to learn science (Eccles, Simpson, & Davis-Kean, 2006).

Historically, science motivation research has adopted four perspectives of motivation (Sirhan, 2007; Vedder-Weiss & Fortus, 2011). According to Vedder-Weiss & Fortus (2011) and Sirhan (2007), the four perspectives include behavioural (with emphasis on concepts such as incentives and reinforcement); humanistic (placing emphasis on students' capacity for personal growth, their freedom to choose their destiny, and their desire to achieve and excel); cognitive (emphasizing students' goals, plans, expectations, and attribution); and social (which emphasises students' identities and their perspectives when studying motivation). For instance, studies conducted by Simpson and Oliver (1990) adopted most of these perspectives as the basis for a large multidimensional longitudinal study performed between 1979 and 1989. The study findings suggested that the science curriculum and practices which were used at that time in schools in the US were not collectively producing students with positive feelings towards science (Jinks & Lorsbach, 2003; Simpson & Oliver, 1990; Vedder-Weiss & Fortus, 2011).

2.3.2 Student Motivation Toward Science

The literature suggest that self-efficacy beliefs determine one's functioning as a human being in that people's level of motivation, affective status, and actions are based more on what they believe than on what is objectively true (Bandura, 1986; Battle, 1966). It can also be said that self-efficacy can also have a significant bearing on one's ability to gain knowledge and make use of it effectively (Areepattamannil et al., 2011; Bandura & Locke, 2003; Bannier, 2010). In addition, there are four major psychological processes through which self-beliefs of efficacy affect human functioning (Bandura, 1997). The first is the cognitive process, which involves the visualization or prediction of beliefs about performance outcomes. Bandura believed that for people who possess a strong perceived self-efficacy, the higher the goals they set for themselves, the more committed they are to achieving them. Thus they make good use of the cognitive processing of information in order to achieve a standard, to focus on a goal, and to direct their judgment on how to achieve that goal (Bandura, 1997, 1986).

Bandura (1986) reports that motivational processes are in operation when people set goals and plan their course of action based on their control belief (their ability to achieve such goals). Self-efficacy beliefs are said to contribute to motivation in several ways; they determine the goals people set themselves, how much effort and time they spend on a given task, and their resilience to failure (Bandura, 1986; 1997; Simpson & Oliver, 1990). Thus, those people with low self-belief opt to give up more easily when faced with difficult situations. In contrast, individuals who possess strong self-beliefs will not allow testing situations to hinder their efforts, and thus they strive, and certainly they achieve. To such an individual, difficulty is viewed as a challenge rather than a hindrance to success, and as a catalyst that promotes better performance (Bandura, 1986).

Human performance due to self-efficacy can be determined by affective processes. These processes are established by a person's beliefs in their coping abilities in stressful situations. People with low self-efficacy allow negative thoughts to control their level of anxiety (Entwistle, Thompson, & Wilson, 1974; Sirhan, 2007; Vedder-Weiss & Fortus, 2011). They focus unnecessarily on their lack of coping mechanisms in potentially threatening situations, and this can hinder their level of functioning.

Finally, selection processes address the choices people make about their environment, which can determine their life path and the subsequent activities they undertake. Thus an individual who has a higher level of self-efficacy is more inclined to consider a wider array of career options before deciding on a set career. It is of interest to note that if the level of self-efficacy can determine a career path, then that career selected may in fact shape life choices based purely on the level of perceived self-efficacy at a particular time. This implies that it is essential that students are given the opportunities to develop their cognitive skills, in order to develop high levels of self-efficacy.

2.3.3 Student Motivation Toward Learning Chemistry

A number of research studies have indicated that motivation plays a major role as far as influencing students learning is concerned (Armitage, 2008: Martin & Dowson, 2009; McInerney & Van Etten, 2004; Sirhan, 2007). As reported by Amitage, individual student motivation is widely seen as a major factor that contributes to different outcomes and academic achievement. At the beginning of any course, students start their study with a set of beliefs about the nature of learning and what they intend to achieve (Biggs & McCulley, 1993; Sirhan, 2007). These beliefs are derived from earlier school and learning experiences as well as their current goals and motives. According to Sirhin, motivation to learn is an important factor controlling the success of learning and that teachers face problems when their students do not all have the motivation to seek to understand. While motivation to learn is important, Entwistle, Thompson and Wilson (1974) say that it does not really determine whether learners employ a deep or a surface approach. Other researchers have reported that there are two aspects of motivation to learn which can be classified into either intrinsic (e.g., wanting to know for its own sake) or extrinsic (e.g., wanting to learn what is on an exam syllabus) (Entwistle et al., 1974; Sirhan, 2007; Vedder-Weiss & Fortus, 2011).

The two ways in which students are motivated are through either intrinsic or extrinsic motivation. The psychological processes and perspective of motivation determine the motivational level of students. These, in turn, affect students by creating and enabling students to develop certain attitudes toward the perceived behaviour. Students' attitude toward science and chemistry is covered next.

2.4 Student Attitude Toward Science and Chemistry

2.4.1 Defining Attitude

An attitude is an imaginary construct that represents an individual's degree of like or dislike for something. Attitudes are generally positive or negative views of a person, place, thing, or event. These are often referred to as the "attitude object". People can also be conflicted or hesitant towards an object, meaning that they simultaneously possess both positive and negative attitudes toward the item in question. Attitudes are judgments. They develop on the ABC model (affect, behavior and cognition) (Breakwell & Beardsell, 1992; Dalgety, 2003; Osborne, Simon & Collins, 2003; Talton & Simpson, 1985). The *affective* response is an emotional response that expresses an individual's degree of preference for an entity; for example, 'studying chemistry is interesting'. According to Dalgety (2003), affective beliefs are arguably the dominant beliefs contributing to attitude, with some authors suggesting that cognitive beliefs and behaviours are not, by definition, attitudinal beliefs (McGurie, 1989). The *behavioral* intention is a verbal indication or typical behavioral tendency of an individual. The *cognitive* response is a cognitive evaluation of the entity that constitutes an individual's beliefs about the object (Dalgety, 2003; Osborne et al., 2003). Most attitudes are the result of either direct experience or observational learning from the environment. These three conceptual components of attitude will be adopted for this thesis, as they provide a basis to understanding students' attitude toward chemistry.

2.4.2 Students' Attitude Toward Science

Numerous studies have highlighted the significance that student attitude plays in determining active learning and enjoyment of science lessons. This section addresses the importance of learning environments on students' attitude in science and the impact that they have on determining enjoyment, learning and achievement. Researchers have reported that students' attitude can also be determined by their desire to achieve, and others argue that it is, in fact, that achievement actually determines students' attitude and that attitude toward and values related to science are important outcomes in science education (Elliot, Hufton, Illushin & Lauchlan, 2001; Hassan, 2008; Hong, 2011; Lin, 1998; Osborne, Simon, & Collins, 2003). Values related to science have a clearly recognizable influence on both science achievement and participation in the study of science and in the choice of career. In the same way, students' attitudes also influence both achievement and participation in science (Bryan, Glynn, & Kittleson, 2011; George & Kaplan, 1998; Keeves & Alagumalai, 1998).

To assist in understanding student classroom behaviour, attitude needs to be defined. Attitude can be learned from experiences and can shape students' behaviour in the classroom. Neathery (1997) reported that students' attitude to science affects their level of participation. It can be assumed that students' actions in a classroom reflect the feeling they have towards a particular activity. These learned attitudes can also change over time (George & Kaplan, 1998; Riffat Un, Sarwan, Naz, & Noreen, 2011). Allport (1985) reported that attitude is a state of mind at which an individual shows readiness for mental and physical activity. Reasoning is a common attribute students have, and thus they often seek reasons for having to learn science - teachers are thus challenged to justify the relevance of the topic. Lin (1998), for example say that integrating history in science teaching could facilitate student conceptual understanding of chemistry. According to Lin, students' attitude toward classroom science appears to be shaped by certain factors such as teachers, learning environments, self-concept, peers and parental influence. However, Morrel and Lederman (1998) observe that the major factor determining learning is the level at which students acquire prior knowledge.

All students have the potential to learn, thus it is important to provide a variety of learning experiences and an environment that promotes positive attitude in the classroom. It is a widely held view that students learn differently (Cook, 1997; Morrel & Lederman, 1998; Sesen & Tarhan, 2010; William, Kurtek, & Sampson, 2011). The ability to know and identify student types can assist teachers in developing more relevant activities geared toward better acquisition of knowledge and an increase in student learning (Briggs & McCaulley, 1993; Cook, 1997). Students' attitude toward learning chemistry is discussed next.

2.4.3 Students' Attitude Toward Learning Chemistry

Investigation of changes to changes in attitude is commonly based on the Elaboration Likelihood Model (ELM) (Dalgety, 2003). ELM, according to Dalgety, suggests that a change of attitude can occur only through a central or a peripheral pathway. The central pathway results in an attitude change that is stable and predictive of behaviour (Dalgety, 2003; Zain, Rohandi, & Jusoh, 2010). An attitude change can only be made if the individual is motivated to change and is able to process new information. To illustrate, consider a chemistry major and a non-major that are exposed to a message from the lecturer. A particular second-year analytical chemistry major may process this message, the non-major - not contemplating a career in chemistry - may not identify this as a personally relevant message (Brossard, Lewenstein & Bonney, 2005; Dalgety, 2003; Riffat Un, Sarwan, Naz, & Noreen, 2011). Information seen in this way will affect the individuals, based on their current beliefs, attitudes and experiences. Thus, for information to change an individual's attitude it must be seen as worthwhile, and related to the individual's own beliefs and attitude. At such a stage, the information can be rejected, which results in the retention of the old belief instead of adoption of new beliefs. For example, if chemistry information is presented in a complex manner, this will impose on students the idea that the task at hand is difficult to carry out, and therefore strengthens their belief that they should not study the course (Dalgety, 2003; Hassan, 2008; Osborne et al., 2003; & Zain et al., 2010). It is also important to note that the prerequisite to having an attitude change is the retention of new knowledge and skills in the individual’s long term memory and making it readily available.

Students’ attitude toward science and chemistry can have either a positive or negative influence in student self-efficacy in regard to chemistry. This is discussed next.

2.5 Self-Efficacy Toward Science and Chemistry

2.5.1 Defining Self-Efficacy

Bandura (1986) separated expectations into two distinct types: self-efficacy and outcome expectancy. He defined self-efficacy as the conviction that one can successfully execute the behaviour required to produce the outcomes. The outcome expectancy refers to a person's estimation that a given behaviour will lead to certain outcomes. He states that self-efficacy is the most important precondition for behavioural change, since it determines the initiation of coping behaviour. In addition, according to Gerhardt and Brown (2006), self-efficacy is an individual’s belief in his/her capability to organize and execute the courses of action required to produce given attainments. It has been reported that high levels of self-efficacy have been found to lead to increased levels of performance across a variety of tasks (Bandura, 1997; Frayne & Geringer, 1994; Gerhardt & Brown, 2006; Jinks & Lorsbach, 2003; Stajkovic & Luthans, 1998a). The self-efficacy construct is derived from social learning theory (Bandura, 1977), later called the social cognitive theory (Bandura, 1986). As far as social cognitive theory is concerned, human functioning is seen as a result of interplay between personal, behavioural, and environmental influences (Aydin, Uzuntiryaki, & Demirdogen, 2011; Bandura, 1986; Pajares, 2002). According to Gerhardt and Brown (2006) and Bandura (1986), social cognitive theory argues for the importance of human agency, viewing an individual as being an agent of influence in his or her own development. In keeping with such a view, an individual is able to exercise control over his or her own thoughts, feelings, and actions. Such control is heavily influenced by an individual’s view of self.

In the following section, the relationship that social learning theory (SLT) and cognitive learning theory (CLT) have with self-efficacy will be discussed followed by students' self-efficacy in regard to science and chemistry.

2.5.2 Social Learning Theory (SLT) and Self Efficacy

Albert Bandura is a recognized theorist in relation to social learning theory and self-efficacy (Bandura, 1977, 1986; Bandura & Locke, 2003; Schunk, 1995). Bandura argued that self-belief is the foundation to success and therefore can determine the individual's level of achievement. Bandura (1986, 1997) reported that those who see themselves as highly efficacious tend to associate their failures with insufficient effort, whereas those of comparable skills, but lower perceived self-efficacy, turn their failures to deficient ability. Such an important comparison assists in understanding the processing of students' interpretations of performance levels and expectations of themselves in the classroom. It is an ongoing process of making decisions, taking a course of actions and how long to continue on with what they have undertaken in life. Bandura argues that these are partly determined by students' judgments of personal efficacy. Students' efficacy can change, and Schunk (1995) asserts that students who do not succeed do not necessarily maintain low self-efficacy if they believe that they have the capacity to perform better. Students' performance on any particular task can be improved with alterations to the level of application to the task. Thus, how individuals interpret the result of their performance attainments informs and alters their environments and their self-beliefs, which in turn inform and alter their subsequent performances (Bandura, 1997; Gerhardt & Brown, 2006; Pajares & Graham, 1999; Schunk, 1995).

Bandura (1986) clarified the meaning of self-efficacy judgements as being concerned not with the skills one has, but with what one can do with whatever skills one possesses. He also distinguished between judgments of personal self-efficacy from response-outcome expectations, stating that personal self efficacy is a judgement of one's capability to accomplish a certain level of performance, whereas an outcome expectation is a judgement of the likely consequence such behaviour will produce (Bandura, 1986; Linnenbrink & Pintirch, 2003). It is therefore, thought that judgements of efficacy determine the level of persistence (Pei-Hsuan, 2008; Tucker, Caraway, Reinke & Hall, 2003). Thus, according to Moores and Chang (2009), when a student is given a task, their analysis has the potential to influence their thought processes and related emotions that can determine their performance. Bandura and Locke (2003) highlighted that self-efficacy beliefs affect how well individuals motivate themselves and persevere in the face of difficulties, their quality of emotional well being, their vulnerability to stress and depression, and the choices they make at important decision making situations in life.

It is important to note that self-belief is one of motivation's most important components (Areepattamannil et al., 2011; Bandura, 1997; Martin, 2003). One can therefore argue that if a student's self-efficacy is low, then their motivation is also low (Walker & Greene, 2009). According to Areepattamannil et al. (2011) and Gerhardt and Brown (2006), since self-efficacy is based on self-diagnosis of one's ability, students within a classroom can interpret their environment quite differently and to a certain degree due to prior classroom experiences. As students progress through their teenage years they are easily influenced by issues regarding acceptance of self or self-belief, which has the potential to affect performances (Areepattamannil et al., 2011; Bandura, 1997). Bandura (1997) believed that success can be determined by self-belief, and therefore an individual's perception of their ability to succeed. Social comparison of students in a classroom cannot be avoided, and thus students' levels of self-efficacy play an important role in motivating them to want to participate in classroom activities. This indicates there is a stronger link between attitudes and achieving self-efficacy (Areepattamannil et al., 2011; Bandura, 1997; Kurbanoglu, 2003). Next to be discussed is the relationship that exists between Social Cognitive Theory and self-efficacy.

2.5.3 Social Cognitive Theory (SCT) and Self Efficacy

A perception of one's capabilities as a result of reflection of one's own conscious is central to Bandura's (1986) social cognitive theory of self-efficacy. He viewed self-efficacy as people's judgements or beliefs about their capabilities that determined performance in events that affect their lives. By reflecting on their varied experiences and on what they know, they can derive generic knowledge about themselves and the world around them. Bandura believed that an individual's self-beliefs determine thoughts and actions, and the way people think, believe and feel affects their behaviour. By reflecting on their actions, individuals can self-evaluate and respond by changing how they think and their subsequent behaviour.

Bandura (1986) say that people form their self-efficacy perceptions from four sources. Firstly, from performance attainment which is interpreted as authentic mastery experiences of one’s past performance. Thus, a strong efficacious belief is formed when a person experiences success, while repeated failures lower self-efficacy (Lent, Brown, & Hackett, 1994; Moores & Chang, 2009; Pajares, 2003). Thus, previous experiences help to create efficacy beliefs. Secondly, vicarious experiences - seeing or visualizing and comparing themselves with other students successfully performing a task - can raise self-efficacy. This type of comparison enables students to model their level of self-efficacy against students who they believe they equate to academically (Bandura, 1986; Stajkovic & Luthans, 1998b; Walker & Greene, 2009). The third factor that is believed to determine self-efficacy is verbal persuasion. This particular technique can be performed by teachers and student peers to encourage an individual in the belief in having the ability and skills to perform a task successfully. Thus both teachers' and student peers' ability to encourage students can influence the level of self-efficacy that a student requires. It has been noted that it is easier to weaken self-efficacy beliefs through negative appraisal than to strengthen them through positive encouragement (Gerhardt & Brown, 2006; Stajkovic & Luthans, 1998b; Walker & Greene, 2009). The final factor that can affect self efficacy, according to Bandura (1986), is the physical and emotional state of a student. Typically students who are stressed and enter the classroom with a negative mindset display more self-doubt, and therefore display low levels of self-efficacy. On the other hand, students with a positive mindset generate higher expectations of themselves and acquire higher levels of self-efficacy. Thus Bandura’s social cognitive theory highlights the view that people are more likely to engage in tasks where success is imminent and less likely to pursue tasks where failure is most likely (Bandura, 1986; Gerhardt & Brown, 2006; Stajkovic & Luthans, 1998b).

Self-efficacy, as indicated here, linked to intended behaviour. Having a high self-efficacy would then be expected to help raise the confidence of engaging the behaviour of students. At the same time having a low self-efficacy would be expected to lower self confidence in students. This means students are less likely want to engage in the behaviour. Therefore, it is reasonable to conclude that students' self-efficacy toward science also influences the attitudes toward engaging within learning science. The importance of students' attitudes toward learning science will be discussed.

2.5.4 Student Self-Efficacy Toward Learning Science

Self-efficacy is a dynamic concept and an individual's self-efficacy is influenced by his/her performance attainments, vicarious experiences, physiological state, and experiences of social persuasion (Bandura, 1986; Dalgety, 2003; Gerhardt & Brown, 2006). The degree of failure or success at which an individual performance is measured determines future attempts to complete tasks of a similar nature. When a person succeeds in a task that is perceived to be difficult, their self-efficacy increases. On the other hand, when an individual fails what is considered to be a simple task or has failed repeatedly on similar tasks, their self-efficacy will reduce (Dalgety, 2003; Gerhardt & Brown, 2006; Stajkovic & Luthans, 1998b).

Self-efficacy, according to Britner and Pajares (2006), is a strong predictor of academic achievement, course selection, and career decisions across domains and age levels. Information about the experience of Year 10 student self-efficacy may help science educators facilitate student progress in science in high school. With the predictable decline in student motivation for studying science (Jinks & Morgan, 2001; Vedder-Weiss & Fortus, 2011), science educators seek to increase science course taking and achievement (Britner & Pajares, 2006; Sahin, 2007; Yusuf, 2011) by examining a wide range of factors that influence academic choices and performances. One potential and a powerful influence is the confidence with which students approach science (Andre, Whigham, Hendrickson, & Chambers, 1999; Britner & Pajares, 2001, 2006; Kupermintz, 2002; Lau &

Roeser, 2002). Britner and Pajares (2006) argue that students' belief in their ability to succeed in science tasks, courses, or activities, or their science self-efficacy, influences their choices of science-related activities, the effort they expend on those activities, the perseverance they show when encountering difficulties, and the eventual success they experience in science (Bandura, 1997; Britner & Pajares, 2001; Zeldin & Pajares, 2000). This has caused science educators to make self-efficacy a key focus with the intention to increase student accomplishment and engagement in science. Bandura (1986) contends that students' self-efficacy beliefs are often better predictors of the academic successes they attain than are objective assessments of their abilities. Schunk (1985) argues that this is because these beliefs mediate the effects of prior achievement, knowledge, and skills on subsequent achievement. Motivation researchers have established that students' self-efficacy in their academic capabilities is related to academic motivation and performance outcomes in domains that include science (Britner & Pajares, 2001; Lent, Brown, & Gore, 1997; Pajares & Valiante, 1997; Shell, Colvin, & Bruning, 1995).

2.5.5 Student Self-Efficacy Toward Learning Chemistry

Self-efficacy beliefs affect academic performance by influencing a number of behavioural and psychological processes (Bandura, 1986, 1997). In chemistry, students who have a strong belief that they can succeed in chemistry tasks and activities will be more likely to select such tasks and activities, work hard to complete them successfully, persevere in the face of difficulties, and be guided by physiological functions of individuals that promote confidence as they meet obstacles. Alternatively, students who do not believe that they can succeed in chemistry-related activities will avoid them if they can, and will put forth minimal effort if they cannot. When confronted with the same challenges that chemistry involves, they will be most likely to give up and to experience the stresses and anxieties that help ensure the erosion of the efforts.

Previous research has observed that science self-efficacy is associated with science achievement and science-related choices across grade levels. At the college or university level for example, science self-efficacy predicts achievement

(Andrew, 1998; Jinks & Morgan, 2001) and persistence in science related majors and career choices (Gwilliam & Betz, 2001; Lent, Brown, & Larkin, 1984; Luzzo, Hasper, Albert, Bibby, & Martinelli, 1999). In high school students, science self-efficacy correlates with science achievement, and is a better predictor of achievement and engagement with science-related activities in and out of the classroom than are gender, ethnicity, and parental background (Kupermintz, 2002; Lau & Roeser, 2002). According to other researchers (e.g., Britner & Pajares, 2001; Jinks & Morgan, 2001; Pajares, Britner, & Valiante, 2000), science self-efficacy predicts science achievement, with girls and white students having higher science grades and stronger self-efficacy than boys and non-whites..

With the demonstrated influence of self-efficacy on achievement in academic domains such as science, it is worth being reminded of the sources of self-efficacy. According to Bandura (1986, 1997) students form their self-efficacious beliefs by interpreting information from four sources. The most influential is the interpretation of previous performances or mastery experience. Students engage in tasks and activities, interpret the results of their actions, and use these interpretations to develop beliefs about their capability to engage in subsequent tasks or activities, acting in concert with the beliefs created. Experiences interpreted as successful generally raise confidence; experiences interpreted as unsuccessful generally lower it. Successes that occur as a result of overcoming challenges may promote a more resilient sense of self-efficacy than those successes that are easily won. Britner and Pajares (2006), however, say that successful mastery experience alone does not determine self-efficacy. Rather, individuals must cognitively process these experiences along with personal and environmental factors that include previously held self-beliefs, the perceived difficulty of the task, effort expended in the task, and help received in the completion of the task.

2.6 Summary

This chapter provides an overview of the theoretical background associated with students' motivation, attitude and self-efficacy when learning science and chemistry. Motivation plays a very important role in engaging students in achieving set goals (Ames, 1992; Dweck & Ellen, 1988; Yusuf, 2011). This is further associated with the concept of learning as a social interaction or entity by observing others (Bandura & Locke, 2003). How confident students feel about doing things and their self-efficacy, contributes to their motivation to learn. Motivation is a very important factor in attaining goals. As is reported by this literature review, students who are motivated learn more effectively, while unmotivated students are likely to cause disturbances in the classroom (Ames, 1992; Dweck & Ellen,1988).

All students have the potential to learn, thus it is important to provide a variety of learning experiences and an environment that promotes positive attitudes in the classroom. It is a widely held view that students learn differently (Cook, 1997; Morrel & Lederman, 1998). The ability to know and identify student types can assist teachers in developing more relevant activities geared towards better acquisition of knowledge and thus increase learning (Briggs & McCaulley, 1993; Cook, 1997; Sesen & Tarhan, 2010). Self-efficacy plays a vital role in student learning of science and chemistry by creating the conviction that the student can successfully execute the behavior required to produce the outcomes (Bandura, 1986). It is a strong predictor of academic achievement, course selection, and career decisions across domains and age levels and thus, should be the focus of all science and chemistry learning (Britner & Pajares, 2006; Walker & Greene, 2009).

The research methodology and design, purpose and objectives, the study rationale and study context employed to obtain students' perception of their motivation, attitude and self-efficacy toward learning chemistry covered in this particular study will be discussed in the next chapter.

CHAPTER 3: RESEARCH METHODOLOGY AND DESIGN

3.1 Introduction

This chapter presents the research methodology and design for this study. The purpose and the research questions will be discussed first, followed by what educational research is, the rationale for choosing the research paradigm, the methodological approach used, the development of the study instruments, and data analysis undertaken in this study.

3.2 Research Purpose and Objectives

As noted in Chapter 1, the aim of this research is to investigate Year 10 students' motivation, attitude, and self-efficacy (i.e., perceived ability to do a specific task) toward learning chemistry. This can then be used to help understand the nature of learners in chemistry learning environments. The intention is to provide insights into alternative ways of teaching and learning that might motivate, change student attitude, and increase their self-efficacy toward learning chemistry.

The basic objectives for the research derived from the broad aims and objectives are:

- To identify Year 10 students self-perception of:
    - Their motivation, attitude and self-efficacy toward learning chemistry; and
- To qualitatively investigate associations between:
    - Student motivation and attitude toward learning chemistry;
    - Student motivation, attitude and self-efficacy toward learning chemistry

3.3 Research Questions

The important questions that arose from the preliminary directed study which explored Year 10 students' attitude toward difficult topics in chemistry conducted in Hamilton, New Zealand concluded that student motivation or engagement with science depends on the topic and whether they think the topic is difficult or not. Thus, it is important to pose questions that enable the gathering of data about student motivation for learning chemistry.

Therefore, the first two research questions to be addressed were:

1. What motivates students to learn chemistry?
2. What inhibits student motivation toward learning chemistry?

Prior research indicates that students' attitudes are a measure of either a direct experience or observational learning (Dalgety, 2003; McGurie, 1989). Students' attitude toward chemistry is therefore considered in relation to the question:

3. What are student attitude toward learning chemistry?

Previous research indicates that in high school students science self-efficacy (the level of confidence one possesses to perform a set task) correlates with science achievement, and is a better predictor of achievement and engagement with science-related activities in and out of the classroom than gender, ethnicity, and parental background (Kupermintz, 2002; Lau & Roeser, 2002). With the demonstrated influence of self-efficacy on achievement in academic domains such as science, it is worth revisiting the sources or antecedents of self-efficacy. Students form their self-efficacious beliefs by interpreting information from previous performances or mastery experience; individual cognitive processing of experiences with personal and environmental factors such as previously held self-beliefs; the perceived difficulty of the task; effort expended in the task; and help received in the completion of the task (Bandura, 1986, 1997; Britner & Pajares, 2006). Students' self-efficacious perceptions toward chemistry in this study are the focus of the next question:

4. What are student self-efficacy beliefs toward learning chemistry?

The association that motivation has with attitude and self-efficacy is of interest to the researcher and thus it is considered in this study. A substantial number of authors suggest that there is a strong link between self-efficacy and academic motivation (e.g., Pajares, 1996; Pajares & Schunk, 2001; Yusuf, 2011) and self-efficacy with academic motivation (e.g., Jinks & Morgan, 1996, 1999; Pintrich & De Groot, 1990; Pintrich & Schunk, 1995; Schunk, 1989, 1995). Both quantitative and qualitative data have been used to explore Year 10 student perceptions with the following questions as the basis for the qualitative approach:

5. What association, if any, is there between student motivation and their attitude toward learning chemistry?
6. What association, if any, is there between student motivation, attitude and self-efficacy toward learning chemistry?

3.3.1 What is Educational Research?

Educational research is a thorough and organized way of carefully carrying out firsthand and important investigation of an unproven idea or an existing possibility about natural happenings and its presumed relations (Cohen et al., 2007; Burns, 2000; Kumar, 1996). It is a way of searching to discover social reality or truth. With this view, truth is seen as a social construct that can only be known by way of researching the researched concern and its affiliates in a given situation. The most successful approach to the discovery of truth through such a search is a matter of experience and logical reasoning (Cohen et al., 2007). Mertens (2005, p. 2) defines educational research as an inquiry in which data are collected, analyzed and interpreted in such a manner as to “understand, describe, and predict or control an educational or psychological phenomenon or to empower individuals in such contexts”. For instance, in Melanesia, data collection, analysis and interpretation are oral entities obtained either through one-on-one interview or in a tribal or clan focus group discussion for the purpose of educating tribal men and women as well as the villagers (Vallance, 2007, 2008; Gegeo & Gegeo, 2001; Gegeo & Gegeo 2002). Educational research, however, as Dash (2005) explains, is concerned with exploring and understanding social happenings or problems that are educational in nature. An example of a formal educational problem would be the factors causing teaching and learning difficulties in chemistry to children in Solomon Island classrooms. In this case, the means of investigating, collecting and drawing out the hidden knowledge of this reality and experiences would be empirical as well as qualitative and descriptive.

Understanding the nature of educational research is vital for novice researchers. Based on this view, Gall, Borg, and Gall (1996) say that awareness of educational research is important in creating a positive attitude toward research, and an awareness of the contribution it can make to the improvement of educational practice. It is like a lens where the researcher views reality through paradigms, a set of assumptions about what knowledge is and how it can be researched (Cohen et al., 2007; Weaver & Olson, 2006).

The two instruments utilized in this study are the questionnaire on Student Motivation, Attitude and Self-Efficacy Toward Learning Chemistry (SMASEC) and the Student Focus Group Interview (FGI). The research approach chosen for this study is the mixed method approach. The methodological approaches or data gathering methods that are available to choose from for the purpose of this study include questionnaires, interviews, accounts, observations, tests, and personal constructs (Table 3.1).

Table 3.1 Methodological Approach available to Researchers (Cohen et al., 2007).

	Methodological Approach	Description
1	Questionnaires	a set of questions that a lot of people are asked as a way of getting information about what people think or do generally
2	Interviews	a meeting during which somebody is asked questions, e.g., by a researcher
3	Accounts	a written or spoken report of something that has happened
4	Observations	the careful watching and recording of something, e.g., a natural phenomenon, as it happens
5	Tests	a series of questions, problems, or practical tasks to gauge somebody's knowledge, ability, or experience
6	Personal constructs	a personal account of life, the world, and people around, constructed based on personal experiences in life and reactions to them.

The questionnaire is a widely used and useful instrument for collecting survey information and is often comparatively straightforward to analyze (Cohen et al., 2007; Johnson & Onwuegbuzie, 2004). The interview is a flexible tool for data collection, enabling various senses to be used: verbal, non-verbal, spoken and heard (Malterud, 2001; Mertens, 2005). Accounts, as a data gathering method, involve giving an account of one's actions in order to make them understandable and reasonable to others (Cohen et al., 2007; Gray, 2004; Kumar, 1996). Observation as a data gathering method offers an investigator the opportunity to be in situ rather than relying on second hand information and it involves investigating naturally occurring social situations (Cohen et al., 2007; Malterud, 2001). In tests, researchers gather data of a numerical value. The personal construct research data gathering method places its emphasis on individuals as the source of absolute truth and thus meaning making is an individual construct (Cohen et al., 2007; Gorard, 2004; Mertens, 2005; Kumar, 1996).

3.4 Research Paradigm

This section will briefly examine what educational research is; the current paradigms in educational research: the positivist paradigm, the interpretive paradigm and mixed methods approach, which emerges from both the positivist and interpretive paradigms.

3.4.1 Current Paradigms in Educational Research

In educational research, the term paradigm refers to a set of basic beliefs, accepted on faith, that provides the basis for the implementation of research as noted by Guba and Lincoln, (1994) and Krauss, (2005). This view is based on assumptions governed by ontology (what is there that can be known?) and epistemology (the nature of human knowledge and understanding that can possibly be acquired) (Guba & Lincoln, 1994; Mac-Naughton, Rolfe & Siraj-Blatchford, 2001; Wilkinson & Morton, 2007). Fawcett and Hearn (2004), Kirkham and Anderson (2002) and Packer and Goicoechea (2000) further add that the connection between ontology, epistemology and methodology (how the inquirer goes about finding out whatever he or she believes can be known) describes a particular research paradigm. Through these assumptions, methodologies and procedures for investigation can be known and effectively used to further contribute to the body of knowledge of reality. In this sense, paradigms also act as guides to the choice of ontology and epistemology in fundamental ways (Cohen et al., *2*007; Creswell, 2003; Guba & Lincoln, 1994). Such views categorize paradigm into two major categories: the scientific/positivistic paradigm, and the social constructivist and expectancy paradigms which includes the following subsets; the interpretive paradigms and the critical theory paradigm. The mixed method approach to research which is a combination of the major categories will also be discussed next.

3.4.2 Positivist/Scientific Paradigm

Positivism, the first major paradigm, has been a regular subject in Western thought from the Ancient Greeks to the present day. Gall et al. (1996) describe the positivist paradigm as the features of the social environment which include an independent reality with constant relations, time, and setting. Positivist researchers develop knowledge by creating and obtaining numerical data on observable behaviors of samples, and subjecting these data to numerical analysis.

In addition, the positivist paradigm about knowledge is such that, it is objective, hard, real and external to the individual (Cohen et al., *2*007; Gray, 2004). Cohen et al. (2007), Mertens (2005) and Descombe (2002), argue a thorough understanding of human behaviour as one that can only be obtained by observation and reasoning. Other researchers, such as Weaver and Olson (2006) and Gray (2004), say that the positivist paradigm arose from strict rules and measurements, truth and absolute principles and predictions of the physical sciences. Positivists are concerned more with quantitative explanation of the data gathered by seeking to create patterns and generalizations across cultures and contexts (Nudzor, 2009; Brown & Baker, 2007).

3.4.3 Interpretive Paradigm

The second major paradigm used in educational research is the interpretive paradigm. This paradigm maintains the worldview that knowledge of reality is internally rooted in humans (Cohen et al., *2*007; Gray, 2004). The central view is that knowledge is created by humans and meanings are attached to behaviour, actions and experiences (Bouma, 1996; Nudzor, 2009; Mertens, 2005). Thus the behaviour and actions of humans in the society generate meaning (Creswell, 2003). Interpretation and description of human interactions are associated with experiences of everyday living. These are the central features of making meaning from these social contexts. Because of this epistemology, the interpretive researchers focus on more qualitative means of collecting data. The procedures for collecting data are through biographical studies (a study of individuals), narrative enquiry (making meaning from people's narratives), ethnographical research (observing interactions in a group’s context) and case studies (a detailed analysis of a person or group). These methodologies are of a qualitative nature and are aimed to produce thick descriptions of the situations observed. Such theories are likely to be varied and have many-sided images of human behaviour depending on the situation and context researched (Cohen et al., *2*007; Gray, 2004; Johnson & Onwuegbuzie, 2004; Johnson, Onwuegbuzie & Turner, 2007).

3.4.4 Methodological Approaches

There are two major and contrasting approaches to educational research: qualitative and quantitative. Quantitative research is the kind of research approach in which the information collected can be analysed according to numbers (Best & Kahn, 1998; Sharp, 2009). The numbers can be generated by research methods such as surveys, experiments, and questionnaires (Malasa, 2007; Maelagi, 2011; Sharp, 2009). In contrast, qualitative research is the kind of research that systematically collects, organises, and interprets a broader range of information (Gorard, 2004; Malterud, 2001). The qualitative approach examines and describes the words and actions of participants in a way that represents the circumstances that the participants may go through, feel or face (Gorard, 2004; Malterud, 200; Mertens, 2005).

3.5 Rationale for Choice of Paradigm and Methodological Approach

This section presents the rationale for choosing the instruments used in this study. Cohen et al. (2007) state that the aim of research methodology "is to help us to understand . . . not the products of scientific inquiry but the process itself" (p. 47). Having a thorough knowledge of research methodologies and how they can be used effectively in any research undertaking is of great importance (Maelagi, 2011; Simi, 2008).

More recently, there have been many research approach designs. These research approaches have become multi-faceted in design and more flexible in their application of methods with mixed methods being seen as more acceptable and common. A mixed-methods approach to research is one which is commonly used and involves gathering both numerical information (e.g., instruments) as well as text information (e.g., interviews) so that the data obtained represents both quantitative and qualitative information (Creswell, 2003; Dash, 2005; Morgan, 2007; Johnson, Onwuegbuzie, & Turner, 2007; Onwuegbuzie & Leech, 2010).

Many researchers, including Creswell (2003), Gorard (2004), and Onwuegbuzie and Leech (2010), view qualitative and quantitative methods as complementary, saying researches should choose the most appropriate method/s for the investigation. While some paradigms may appear to lead a researcher to favour qualitative or quantitative approaches, in effect no one paradigm actually prescribes or prohibits the use of either methodological approach. The mixed research is a partner of both qualitative and quantitative paradigms sharing a common goal and that is to increase knowledge base by conducting trustworthy meaningful research (Dash, 2005; Johnson & Onwuegbuzie, 2004; Morgan, 2007; Onwuegbuzie & Leech, 2010).

The basic reasons for choosing the mixed methods approach for this study are triangulation, complementarities, methodology development, and expanding the range of an inquiry. Firstly, the mixed methodological approach was chosen for purposes of triangulation - that is seeking to unite, merge and justify the findings from the two different methods/paradigms used in this study. Secondly, it is for complementary purposes - that is, seeking to obtain different dimensions, a clearer picture, a degree of detail, and clarity of results and findings obtained from both the quantitative and qualitative data. Thirdly, it was for research methodology development – that is to conduct a self-administered questionnaire and use its results to help inform the focus group interview. Fourthly, the mixed method approach was chosen for expanding the breadth and range of inquiry by using different methods to address the research questions (Cohen et al., 2007; Johnson, & Onwuegbuzie, 2004; Onwuegbuzie & Leech, 2010).

3.5.1 Method – Survey and Questionnaire

The mixed methods approach adopted in this research is one in which a survey using a questionnaire followed by a semi-structured interview within a focus group is used (Appendices E & F). The choice of survey as a research tool lies in its ability to gather generalizations within given situations and circumstances. Its ability to make statements, which are supported by a large data, and its ability to establish the degree of confidence which can be placed on a set of findings, are other reasons for its choice (Cohen et al., 2007; Gorard, 2004; Morgan, 2007).

The use of a self-completion rating scale questionnaire as a tool by way of a 5-point Likert-type scale is used in this study. The self-completed questionnaire was designed specifically for this study and is attached in Appendix E. Students are asked to respond to each of the items in the 5-point Likert scale. This method was chosen based on its ability to build in a degree of sensitivity and differentiation of responses while still generating numerical data (Cohen et al., 2007; Creswell, 2003; Onwuegbuzie & Leech, 2010).

3.6 Survey Development

Within this section the way the study instrument was developed, piloted, and validated will be discussed, as well as the population and sample.

3.6.1 Scale/Item Selection

In years of teaching science and chemistry, I have noticed that there is a vast array of student capabilities, abilities, motivation, attitudes and self-efficacy toward learning chemistry that have been ignored within the teaching and learning of chemistry. This has caused me to have the desire to explore the reasons why students display such lack of confidence in, motivation for, and attitude toward learning chemistry.

The survey scale/items used in this survey were obtained through conducting a literature review and by consultation with the science curriculum in Solomon Islands – *Natural and Processed Materials* at Year 10 (Form 4).

3.6.2 Selection of Measuring Instrument

The 32-item SMASEC that was used in this study was adapted from *Students' Motivation and Self-Efficacy in Science* (SMASES) (Reid, 2007) which was formed by collating relevant sections of the *Students' Motivation Towards Science Learning* (SMTSL) (Tuan, Chin, & Shieh, 2005) to measure students' motivation (14 items); the Attitudes Toward Science scale (10 items) which was adapted from *Test of Science-Related Attitudes* (TOSRA) (Fraser, 1981) that measured students' enjoyment of science; and an academic self-efficacy scale (8 items) obtained from the Attitude and Efficacy Questionnaire (AEQ) (Fisher, Aldridge, Fraser, & Wood, 2001). All three instruments had high internal consistency and proved to be valid for use in contexts similar to this research. The combination of aspects of SMTSL, TOSRA and AEQ and the extensive review of their past use, secured in the researcher's mind the need to devise SMASES, which is adapted for this study as SMASEC (Reid, 2007). For the purpose of this study, the

SMASEC instrument focus is on the subject matter, Chemistry, instead of general science.

This adapted instrument measured students' motivation, attitude and self-efficacy toward science. Thus, the SMASEC became an instrument that was framed to the researcher's topic. The scales were considered to be most important for this particular study. The SMASEC questionnaire comprises 32 items under five different scales and sub-headings (Chemistry Learning Value, Performance Goals, Achievement Goals, and Attitudes Toward Chemistry, and Self-Efficacy Toward Learning Chemistry)(Appendix E).

3.6.3 Piloting the Survey

The wording of questionnaires is vital, as is pre-testing. The piloting of the questionnaire is to increase the reliability, validity, and practicability of the questionnaire. In addition, as was discovered from the pilot, the difficulties in understanding the words and the elimination of ambiguities within the illustrated examples would not be possible without the pilot.

The self-completed questionnaire (SMASEC) was piloted using a sample of a class of students similar to population to be surveyed. The questionnaire was given to a class of 50 students in one of the Council schools identified in Honiara. It was followed by identifying a total of 10 students for a focus group interview. The interview was conducted to gather more detailed and more depth from students' explanations and understanding of the survey instrument. The SMASEC was then re-evaluated and reviewed. The survey was then piloted for the second time with another class of n = 50 Year 10 students. The validity, reliability and practicality of the SMASEC items were further peer reviewed by three Year 10 science teachers and three head of secondary science teachers before the items were finalized and used in the data gathering process.

3.6.4 Survey Population

The research populations were Year 10 students at four selected schools in Honiara, Solomon Islands within the Honiara City town boundary. The sample surveyed is n = 258 students. The pool of student participants was selected from Year 10 class of students in eight different classes (C1, C2, C3, C4, C5, C6, C7 & C8) within four different schools (S1, S2, S3, & S4). The schools selected were based on schools that offer Year 10 chemistry (either as part of general science or as a subject on its own), to the students having teachers that are qualified, trained chemistry and science teachers, and those who have given consent to participate in the study. Within the four selected schools, two of the four Year 10 teachers have obtained their Bachelor of Science degrees majoring in chemistry and physics at the University of the South Pacific (USP), along with a Graduate Diploma in Science Teaching (GDipTSc) at the School of Education (SOE) at the Solomon Islands College of Higher Education (SICHE). The four university graduates have taught chemistry in Year 10 for more than 15 years. The fourth Year 10 teacher has been teaching for more than 5 years.

Information intended to be obtained is concerning Year 10 students' views or perspectives on their motivation, attitude and self-efficacy toward learning chemistry. This was obtained from students after they had completed the SMASEC questionnaire. From those who completed the survey questionnaire (n=258), a total of 80 students were randomly selected for the focus group interview. The selection was made in correlation with those who participated in the survey and used their class list. Further adjustments in terms of students selected for the interview were made on the day of interview with respect to replacing students who were not present with those who are present and had completed the survey. This was done by selecting students from a reserve list, as identified by the researcher.

Access to the participants was obtained by seeking respective school authorities to produce a letter of approval for conducting the study with the respective schools and principals concerned. A signed consent form was also issued and signed by the school principals as proof of having granted approval for the study (see Appendix D). This was used both formally and informally as proof to all school employees that consent was given to gain access to the target group. In the case of this study, the consent letters were sent to each of the Education Directors of the four education authorities (EA1, EA2, EA3, & EA4) for approval. In addition, similar consent letters were sent to each of the principals of the four schools selected (S1, S2, S3, & S4).

3.6.5 Validity

Validity refers to the degree to which this study accurately reflects or assesses student motivation, attitude and self-efficacy toward learning chemistry. For the purpose of this study, both *external* and *internal* validity will be considered. External validity refers to the extent to which the results of this study can be generalized or are transferable (Cohen et al., 2007; Golafshani, 2003). To ensure that the data obtained is externally valid, the sample population was randomly selected in such a way that it is representative of all Year 10 students within Secondary schools in the Solomon Islands. This is done by randomly selecting four different secondary schools with a range of student abilities in Year 10 in Honiara. In addition, the researcher, being a Solomon Islander, is familiar with the Solomon Islands context and thus identifies a gradient of similarity with which similar studies had been conducted elsewhere (see Figure 3.1 below) (Reid, 2007).

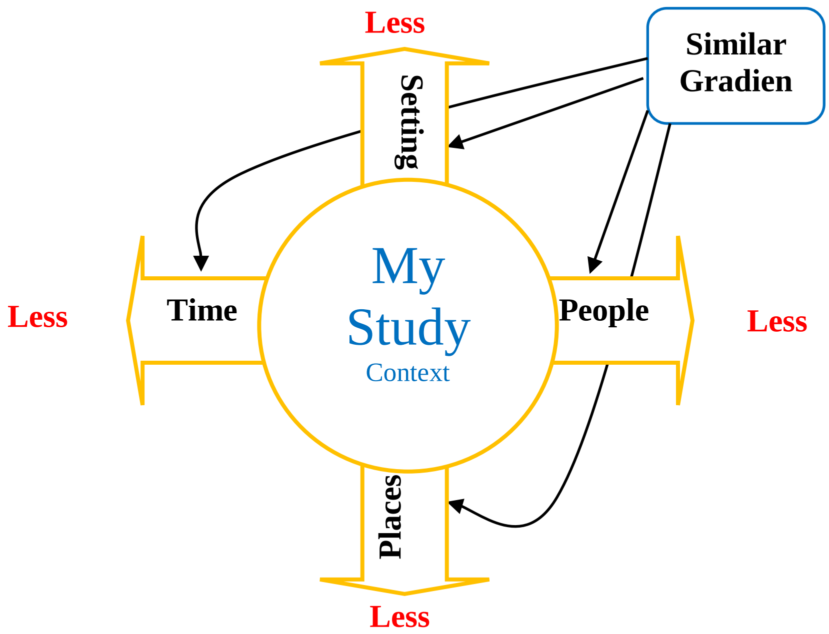

Figure. 3. 1 Similar gradients in study context

Internal validity, on the other hand, refers firstly to the thoroughness with which this study was conducted (Cohen et al., 2007; Golafshani, 2003). This was achieved through the careful planning of the study design, as well as in ensuring that care is taken while conducting the survey questionnaire to measure what it intends to measure. Secondly, this study had taken into account the extent to which it would impact on study participants by ensuring that any causal behaviour explored accurately measured students motivation, attitude, and self-efficacy toward learning chemistry.

While validity is concerned with the study's success at measuring what the researcher sets out to measure, reliability is concerned with the accuracy of the actual measuring instrument or procedure (Golafshani, 2003).

3.6.6 Reliability

Reliability is the extent to which an experiment, test, or any measuring procedure yields the same result on repeated trials (Cohen et al., 2007; Golafshani, 2003). This study is designed to ensure that the replication of its procedures by independent observers can be possible. This is achieved within this study with the ability of the SMASEC questionnaire to be used in similar study contexts in the future. The ability to use SMASEC and the study procedures to yield consistent results and measurements would enable researchers to satisfactorily draw conclusions, formulate theories, or make claims about the generalizability of their research in the future.

Reliability is such an important concept that it has been defined in terms of its application to a wide range of activities. For the purpose of this study, however, internal consistency will be briefly discussed. Internal consistency can be defined as the extent to which tests or procedures assess the same characteristic, skill or quality. It is a measure of the precision between the observers or of the measuring instruments used in a study (Cohen et al., 2007; Golafshani, 2003; Gorard, 2004). The internal consistency for this study assists in the interpretation of research data obtained. The internal consistency enables predictions to be made for the value of scores and the limits of the relationship among the study scale variables. For example, the SMASEC questionnaire was designed to find out about Year 10 students' motivation, attitude and self-efficacy toward learning chemistry. Analyzing the internal consistency of the survey items dealing with motivation, attitude and self-efficacy revealed the extent to which items on the questionnaire focus on these notions (see Table 4.1).

3.7 Data Generation Procedures and Collection

The data collection was made within a period of a month from October to November in 2011. With approval granted by the Centre for Science and Technology Education Research (CSTER) Ethics Committee at the University of Waikato (UoW), in September 2011, I went to conduct a four week field study in Honiara, Solomon Islands. Prior to my travel I had submitted my research notification, and application letter (Appendix B) seeking approval from the research committee of the Ministry of Education and Human Development Resource (MEHRD) to conduct the study. In addition, consent letters were sent prior to my travel to the Solomon Islands to the principals of schools, and respective Education Authorities (Appendix B). This was done by sending letters to my contact in Honiara by email which was printed and hand delivered to the respective authorities. This is one of the most effective ways to obtain prompt responses in Solomon Islands (Kakai, 2010). Permission to collect information from the school and students was granted on the first week and thus collection of data started in week one.

3.7.1 Participant Selection

This research involved four Year 10 secondary schools with eight to ten Year 10 student classes (four urban schools) who study chemistry in Honiara, Solomon Islands. The sample was 258 students. For the focus group interview, a random selection of 10 participants was made using the class register with the help of the chemistry teacher in charge in the eight classes.

In undertaking this research initiative and to fulfil formal obligations, a formal request in writing informing and seeking permission to undertake this research study in the Solomon Islands was sent to the chairperson of the Research Committee of the Ministry of Education and Human Resources Development with a copy of the signed research design proposal (Appendix B). Correspondence of a similar nature was sent to the Education Secretaries of the South Seas Evangelical Church (SSEC) Education Authority, the Church of Melanesia (COM) Education Authority, the Catholic Education Authority (CEA), and the Director of Secondary Division of the Ministry of Education and Human Resources Development in Honiara (Appendix B). Copies of similar correspondence were also sent to each Principal of the selected secondary schools with information in writing about the research project to invite the Year 10 students of their respective schools to participate in this research study (Appendix C).

The researcher strived to ensure that student participants fully understood the nature of their involvement in the research undertaken before conducting the survey. Teachers' and Principals' consent was seen as a higher authority by the students and they asked to sign the consent form on behalf of their students to indicate their school's assistance, availability and willingness to participate in the research. This case is the normal practice in the Solomon Islands schools where the school principals and teachers are seen as representing the students' parents while they are at school and during school hours.

3.7.2 Data Collection and Collation

Collection and collation of data was conducted in two stages. First the eight classes of Year 10 students completed the Students' Motivation, Attitude and Self-Efficacy Toward Learning Chemistry Questionnaire (SMASEC) (Appendix E). All student participants were invited to complete the questionnaire together as a class upon consultation with their chemistry teacher (15 – 30 minutes).

For the focus group interview, all selected participants (10 students per group/class) were invited to do an interview in their respective groups in the students' class or at a suitable location and time. The duration of the semi-structured interviews was approximately 20 to 40 minutes. The interview questions were given to the students prior to their actual interview scheduled time (Appendix F). Arrangements were also made with student participants and the teachers concerned prior to the focus group interview sessions to identify times convenient to them. Also permission was requested from (and granted by) the student participants for the focus group interview to be audio-taped and transcribed.

A tentative schedule of the entire process of engaging the principals, teachers' and student participants had four phases.

Phase 1. On site briefing with school principal, teacher and the student participants and the identification of suitable dates for data collection.

Phase 2. Conduct survey questionnaire with students.

Phase 3. Conduct focus group semi-structured interviews with student participants, with audio recording of interviews (20 to 40 minutes).

Phase 4. Focus group interview data transcription and transcription proof reading.

3.7.3 Data Recording

All data collected and collated (audio recordings, transcripts, written or printed documents) were kept only by the researcher after approval and consent was sought and granted by the participants who own the raw data. The raw data collected were labelled using pseudonyms and stored in a locked cabinet in the researcher's office at the Centre for Science and Technology Education Research, University of Waikato, Hamilton. All recorded interview audio files and questionnaire documents and findings were password protected in separate files and kept in a locker/safe place.

Furthermore, the researcher ensured that no data used in the thesis resulted in identification of any participant or their school. Raw data will be stored for a minimum of five years securely, before it will be destroyed.

3.8 Data Analysis

This section outlines the data analysis techniques used in this study. There are three basic data analysis techniques used to analyze the data collected. They are:

- Cross Tabulation of the quantitative data;
- Use of Analysis of Variance (ANOVA) to check the validity and reliability of the study results; and
- Focus group – thematic analysis.

3.8.1 Cross Tabulation

The first analysis technique used in this study is cross-tabulation which is a quantitative analysis technique used for the purpose of presenting the students' topic ratings responses in relation to the topic items. Within the cross tabulation for analysis, the following conventions are applied. The nominal data, which are the topics, are placed in rows, and the ordinal data (the 5-point Likert scale) is placed in columns (see Table 4.3). As reported by Cohen et al. (2007), this is a form of analysis that is responsive to the data being presented, and that it is most closely concerned with seeing what the data themselves suggest. Thus, to discover the students' rating of their motivation, attitude, and self-efficacy toward learning chemistry, the data on each item/scale is cross tabulated with other students' responses as per their 5-point Likert scale ratings. From the table, the mean of students' rating for each of the items is then calculated, with their overall mean.

3.8.2 Analysis of Variance (ANOVA)

The second data analysis is through analysis of variance (ANOVA). The purpose of this analysis is to test for statistically significant differences between means. The analysis of the mean is done in this case to ensure that there is confidence in inferring from the data collected and its implications for the entire population of Year 10 students in the Solomon Islands. The mean is an informative measure of the central tendency of the variables by which the "true" (population) mean is located with a given level of certainty (Cohen et al., 2007) (Tables 4.1 & 4.2).

3.8.3 Thematic Analysis

The third analysis technique used in this study is that of a thematic analysis of data obtained from the focus group interviews conducted. As a qualitative data analysis technique, the data analysis is almost inevitably interpretive. Thus, the data analysis is more reflexive and represents the reactive interaction between the researcher and the contextualized data (recorded interview scripts) that are already interpretations of a social encounter (Cohen et al., 2007).

Data collected from the interview were analyzed by generating meaning from spoken and transcribed interview data. This was done by counting the frequencies of occurrence of ideas, words and pieces of data and categorizing them into themes (see Table 4.4). Patterns and themes which stem from repeated themes, and explanations or constructs from the interview were then obtained as the researcher tried to make good sense of the data, using informed insights to reach a conclusion.

3.9 Ethical Concerns

3.9.1 Access to Participants

After gaining the ethical approval, permission was sought immediately after in writing, telephone conversion, email and fax to the various authorities in Solomon Islands: the Ministry of Education and Human Resources Development, respective education authorities where the research study was conducted, the principals of the selected secondary schools and the student participants.

3.9.2 Informed Consent

The original submission to the ethics committee was such that the consents were expected to be obtained from participants and parents. The situation faced by the researcher was, however, not as was proposed. This is because the authority of the Principal and the teacher in charge was seen as sufficient to allow students to be involved in this study since most of them are 14 years and older. The parents' consent was, therefore, not sought. This is a common practice in Melanesian context where the school principals are seen as having the authority over students. The respect rendered to the Principal, therefore, takes the place of parental role as the authority figure at school (Valance, 2007, 2008).

3.9.3 Confidentiality

The supervisor of this master thesis and I have direct access to information/data collected. All recorded interview audio files and questionnaire documents and findings were password-protected in separate files and kept in a locker/safe place. Each participant's identity was protected by ensuring that the participant's individual right to privacy is observed. The personal data or information with the identity of the research participants will remain anonymous. Thus, confidentiality of participants' identities was maintained. Participants' data in documents are also filed separately in password-protected files. In addition, participants were coded so as not to identify individuals. One way of protecting the research participants is through the promise of confidentiality (Cohen et al., 2007; Gorard, 2004). This is done verbally by reiterating to students that no one will be identified within the research final report or publications.

3.9.4 Potential Harm to Participants

The data gathered were used to write my report and potentially for publication or conference-presentation. The minimizing of potential harm to participants was a priority. This was done by ensuring that participants were not directly identified in the report of this research. The research findings, therefore, were covered in broad terms with overall themes identified from the study.

3.9.5 Participants' Right to Decline

Participation in the research project was on the basis of informed consent by a high authority (Principals & Chemistry Teachers), and voluntary, with participants having the right of withdrawal at any time.

3.9.6 Participants' Information Sheet

The introductory notes and goals of the research and related activities were given to the respective school principals, teachers and participants in the form of Informed Consent letters, Participant's Information Sheet and Consent Forms before the survey was conducted (Appendices A, C & D). Information about the research and its related activities was disclosed to participants. This was to ensure that the consent was fully informed. The consent sought ensured that participants could freely choose not to take part in the research. The nature of the research was highlighted to participants to ensure they understand the study and that mature decisions are made.

3.9.7 Use of Information

The data gathered were used for the write up of this thesis, and are intended to be used for a publication or conference-presentation. The research findings were covered in broad terms with the overall themes that are identified from the study.

3.9.8 Conflicts of Interest

As a student researcher, I do have my intentions and expectations for conducting the research. However, the student perspective was given a voice. With the focus group interview, the entire discussion was focussed on finding out students' responses and perceptions about their motivation, attitude and self-efficacy toward learning chemistry. Participants' interests were maintained at all times while focusing attention on the research objective. A possible conflict of interest was concerning what benefits the study will bring and to whom. In such cases, it was made clear to participants that this study could bring both personal and educational benefits. For example, it may lead to the improvement of learning, improved approaches to the teaching of chemistry, an increase in motivation and attitude and self efficacy for both students and teachers in schools. The recipient of the benefit has to be factored into the discussion in that this study is part of a Master's of Science in Science and Technological Education qualification.

3.9.9 Other Ethical Concerns

The researcher strived to maintain neutrality in his approach and encourage open dialogue with all participants to allow flexibility so that it was easy to accommodate any unforeseen circumstances that might jeopardize the participants' participation or divert the research goals.

At all times during the research process, the researcher sought to ensure that the questions asked were focused entirely on the research questions so that the participants could be assured that their privacy was not invaded in any way, or, that they may feel that their time has been inappropriately spent.

3.9.10 Dispute Resolution Procedure

The researcher ensured that all participants are well informed about the strategies to resolve disputes prior to commencement of research. Participants were also notified that should there be any dispute during the research process it will be the responsibility of the researcher to carry out initial consultative dialogue with the participants to resolve the dispute. However, should no subsequent resolution be reached the participants could contact the researcher's supervisor for further advice and deliberation. The contact address, email and phone numbers of both the researcher and the supervisor were printed on the information sheet that was given to the participants, teachers, principals, and other appropriate heads of the respective education authorities concerned.

3.10 Ethical Statement

The project followed the University of Waikato Human Research Ethics Regulations 2008 and the ethical guidelines of the NZARE and included the following: informed consent of participants was obtained, without coercion; exploitation (or perception of exploitation) of researcher-participant relationship was prevented; privacy and confidentiality was respected. The participants' own the raw material collected, and their requests' regarding the material was honoured. Participation in the research did not impact academically on the participants.

3.11 Summary

In summary, this research design was framed through a mixed method approach and incorporated through the interpretive paradigm. The quantitative data for the study was obtained by using the SMASEC questionnaire which was later used as the basis of an in depth study within the interpretive paradigm. The qualitative data for this study were then obtained with the use of semi-structured interviews designed within a focus group setting. The data were transcribed and analyzed thoroughly to provide a genuine account with credible explanations and interpretations of the participants' views about the phenomenon investigated. Ethical considerations were adhered to, and validity and reliability were enhanced throughout the process of this study. For this reason, the findings of this study are considered trustworthy and worth paying attention to (Cohen et al., 2007; Guba & Lincoln, 1994; Golafshani, 2003). The study findings are presented next in Chapter 4, followed by the discussion, conclusion and recommendations in Chapter 5.

CHAPTER 4: RESEARCH FINDINGS

4.1 Introduction

The research findings from this study are discussed under three sections: students' motivation toward learning chemistry (chemistry learning value; performance goal; and achievement goal); student attitude toward learning chemistry; and student self-efficacy toward learning chemistry. Student perceptions of factors that contributed toward learning of chemistry are derived from the statistical tests conducted on the quantitative (SMASEC Questionnaire), and also from qualitative (focus group interview) data. Associations between student motivation, student attitude and self-efficacy toward studying chemistry are then examined. Evidence is presented to suggest that student motivation and attitude has an influence on student self-efficacy toward learning chemistry, and vice versa. Conclusions are then drawn to recommend some ways of improving motivation, promoting positive attitude and self-efficacy toward learning chemistry. The chapter concludes by looking at the significance of the research findings.

4.2 Students' Motivation Toward Learning Chemistry

As noted in Chapter 3, the SMASEC questionnaire was organized into five scales. Each scale asked the students to rate items about their perceived motivation (Chemistry learning value; Performance goal; and Achievement Goal), and attitude toward learning chemistry, and the confidence they have in their ability to succeed in learning chemistry. The first scale under motivation is divided into three (3) sub-scales, asking the respondents to evaluate the overall importance of learning chemistry, how they view their performance and achievement goals in learning chemistry. During the focus group interviews, the students were invited to explain their responses to the survey. They were further asked why they had chosen to study chemistry, and to expand on the issues highlighted in the questionnaire. Students were also asked to elaborate on experiences they felt affect the effective learning of chemistry. The findings are presented here within the SMASEC questionnaire framework of scales; chemistry learning value; performance goal; achievement goal; attitude toward chemistry; and self-efficacy toward chemistry.

Table 4.1 below presents reliability data for the SMASEC questionnaire. The Cronbach's Alpha ranges from 0.97 to 0.99, indicating that the questionnaire used is reliable.

Table 4.1 Reliability Summary Data (Cronbach's Alpha for the Student Motivation, Attitude and Self-Efficacy Toward Learning Chemistry (SMASEC), n=258)

	Scale Name	No. Of Items	Reliability Statistics
			**Cronbach's Alpha*
A	Chemistry Learning Value	5	0.97
B	Performance Goal	4	0.97
C	Achievement Goal	5	0.98
D	Attitude Toward Chemistry	10	0.99
E	Self-Efficacy Toward Chemistry	8	0.98

*Cronbach's Alpha – coefficient of reliability, a measure of the internal consistency or reliability of SMASEC for the sample examined.

Table 4.2 below presents the scale mean and standard deviation data for the SMASEC questionnaire used in this research.

Table 4.2 Scale Means and Standard Deviations Data for (Student Motivation, Attitude and Self-Efficacy Toward Learning Chemistry (SMASEC), n=258)

	Scale Name	No. of Items	Scale Statistics			*Grand Mean
			Mean	*Variance*	*STDEV*	
A	Chemistry Learning Value	5	8.55	14.31	3.78	1.71
B	Performance Goal	4	12.01	19.74	4.44	3.00
C	Achievement Goal	5	9.68	20.14	4.49	1.94
D	Attitude Toward Chemistry	10	21.51	83.46	9.14	2.15
E	Self-Efficacy Toward Chemistry	8	21.41	59.57	7.72	2.68

* Grand Mean – is the average mean for each of the scales respectively.

4.2.1 Rating Scale Interpretation

The data discussed below were interpreted using the scales of the research instruments used in the study. When student ‘agreement’ is mentioned this refers to a combination of strongly agree (SA) and agree (A), and, the strongly disagree (SD) and disagree (D) are combined, and are interpreted as ‘disagreement’. Responses of ‘neither agree, nor disagree’ (NAD) are classified as neutral. The interpretation above is also represented in terms of percentages, in which the two separated percentages of each agree and disagree scale are combined. For instance, for item 1, 86 percent agreement is a combination of 38 percent ‘strongly agree’ with 48 percent ‘agree’. Similarly, for item 8, 61 percent disagreement is obtained by combining the 33 percent ‘disagree’ with 28 percent ‘strongly disagree’ rating scales (Table 4.3).

4.2.2 Interpretation of Scale Means

Similarly, the mean value of less than or equal to (≤) 2.0, is taken to indicate an agreement with the statement, and a mean greater than (>) 3.0 to indicate disagreement with the statement. This, in turn, would imply that the smaller the number, the greater the extent of agreement, and the bigger the number, the greater the disagreement.

Table 4.3 presented on the next page contains the results for the entire questionnaire used in this study. Each question item with their ratings by the entire sample (n=258) of Year 10 students is presented here (Table 4.3).

Table 4.3 Student Motivation, Attitude, and Self-Efficacy Toward Learning Chemistry (SMASEC) Cross Tabulation Results Table

	(N_{total} = 258)	Rating Scale + Student Responses							
Item	**Scales**	**SA 1 n (%)**	**A 2 n (%)**	**NAD 3 n (%)**	**D 4 n (%)**	**SD 5 n (%)**	**Tot. n (%)**	**Mean**	**STDEV**
	A. Chemistry Learning Value								
1	*Relevance of chemistry to everyday life*	**99** 38	**124** 48	**30** 12	**4** 2	**1** 0	**258** 100	***1.78***	***0.38***
2	*Learning chemistry stimulates thinking*	**96** 37	**126** 49	**23** 9	**8** 3	**5** 2	**258** 100	***1.84***	***0.36***
3	*Learning chemistry to solve problems*	**106** 41	**104** 40	**30** 12	**15** 6	**3** 1	**258** 100	***1.86***	***0.28***
4	*Participation in experimental activities is important in chemistry*	**196** 76	**55** 21	**6** 2	**1** 0	**0** 0	**258** 100	***1.27***	***0.33***
5	*Learning chemistry & curiosity*	**113** 44	**101** 39	**30** 12	**9** 3	**5** 2	**258** 100	***1.81***	***0.28***
		Average Mean & STDEV values						***1.71***	***0.32***
	B. Performance Goal Toward Learning Chemistry								
6	*Do chemistry to get good grades*	**86** 33	**104** 40	**46** 18	**20** 8	**2** 1	**258** 100	***2.02***	***0.29***
7	*Do chemistry to do better than other students*	**48** 19	**70** 27	**63** 24	**56** 22	**21** 8	**258** 100	***2.74***	***0.27***
8	*Do chemistry so others think I am smart*	**15** 6	**42** 16	**45** 17	**85** 33	**71** 28	**258** 100	***3.60***	***0.60***
9	*Do chemistry to gain teacher's attention*	**19** 7	**29** 11	**52** 20	**81** 31	**77** 30	**258** 100	***3.65***	***0.62***
		Average Mean & STDEV values						***3.00***	***0.44***
	C. Achievement Goal Toward Learning Chemistry								
10	*When I get good grades, I really achieve my goal in chemistry*	**137** 53	**82** 32	**25** 10	**11** 4	**3** 1	**258** 100	***1.69***	***0.24***
11	*I gain confidence in content when I achieve my goal in chemistry*	**87** 34	**128** 50	**31** 12	**9** 3	**3** 1	**258** 100	***1.89***	***0.37***
12	*In solving difficult chemistry problems, I achieve my goal*	**117** 45	**94** 36	**28** 11	**16** 6	**3** 1	**258** 100	***1.81***	***0.25***
13	*Teachers' acceptance of my ideas means I achieve my goal.*	**81** 31	**116** 45	**39** 15	**18** 7	**4** 2	**258** 100	***2.02***	***0.31***

14	*Students accepting my ideas means I achieve my goal in chemistry*	**63** 24	**108** 42	**52** 20	**24** 9	**11** 4	**258** 100	***2.27***	***0.26***
		Average Mean & STDEV values						***1.94***	***0.29***
	D. Attitude Toward Learning Chemistry								
15	*Looking forward to chemistry lessons*	**81** 31	**106** 41	**45** 17	**17** 7	**9** 3	**258** 100	***2.10***	***0.26***
16	*Chemistry lessons are fun*	**42** 16	**74** 29	**78** 30	**44** 17	**20** 8	**258** 100	***2.71***	***0.28***
17	*I enjoy the activities we do in chemistry*	**77** 30	**119** 46	**42** 16	**13** 5	**7** 3	**258** 100	***2.05***	***0.32***
18	*The chemistry we do includes the most interesting things at school*	**44** 17	**95** 37	**86** 33	**22** 9	**11** 4	**258** 100	***2.46***	***0.36***
19	*I want to find out more about the world we live in*	**145** 56	**94** 36	**13** 5	**6** 2	**0** 0	**258** 100	***1.53***	***0.32***
20	*Finding out about new things is important*	**184** 71	**66** 26	**2** 1	**6** 2	**0** 0	**258** 100	***1.34***	***0.32***
21	*I enjoy chemistry lessons in this class*	**55** 21	**114** 44	**55** 21	**22** 9	**12** 5	**258** 100	***2.31***	***0.29***
22	*Love talking to my friends about what we do in chemistry*	**60** 23	**116** 45	**52** 20	**26** 10	**4** 2	**258** 100	***2.22***	***0.32***
23	*We should have more chemistry lessons each week*	**73** 28	**89** 34	**62** 24	**26** 10	**8** 3	**258** 100	***2.25***	***0.25***
24	*I feel satisfied after a chemistry lessons each week*	**37** 14	**104** 40	**73** 28	**29** 11	**15** 6	**258** 100	***2.54***	***0.31***
		Average Mean & STDEV values						**2.15**	**0.30**
	E. Self-Efficacy Toward Learning Chemistry								
25	*I find it easy to get good grades in chemistry*	**29** 11	**77** 30	**85** 33	**46** 18	**21** 8	**258** 100	***2.82***	***0.33***
26	*I am good at this subject*	**18** 7	**85** 33	**85** 33	**45** 17	**25** 10	**258** 100	***2.90***	***0.34***
27	*My friends ask me for help in this subject*	**22** 9	**96** 37	**82** 32	**46** 18	**12** 5	**258** 100	***2.73***	***0.37***
28	*I find chemistry easy*	**14** 5	**66** 26	**78** 30	**69** 27	**31** 12	**258** 100	***3.14***	***0.39***
29	*I perform better than most of my classmates in chemistry*	**22** 9	**60** 23	**79** 31	**74** 29	**23** 9	**258** 100	***3.06***	***0.42***
30	*I have to work hard to pass chemistry*	**179** 69	**67** 26	**10** 4	**2** 1	**0** 0	**258** 100	***1.36***	***0.31***
31	*I am an intelligent student*	**34** 13	**89** 34	**95** 37	**27** 10	**13** 5	**258** 100	***2.60***	***0.39***

32	*I help my friends with their homework in chemistry*	**24** 9	**87** 34	**82** 32	**47** 18	**18** 7	**258** 100	***2.80***	***0.34***
		Average Mean & STDEV values						**2.68**	**0.36**

<u>Key:</u>
SA = Strongly Agree, NAD = Neither Agree nor Disagree, D = Disagree, SD = Strongly Disagree, STDEV = Standard Deviation

Table 4.4 Summary of Findings for the Student Motivation, Attitude & Self-efficacy Toward Learning Chemistry (SMASEC)

Themes	**Concepts (Question no)**	**Description**	**Comments**
1. Motivation Toward Learning Chemistry			
A. Chemistry Learning Value	**A.** Importance of chemistry in life (1)	Extent to which students see the importance of chemistry in life	• Chemistry is seen as important in life because all material is made up of atoms and that to understand what, why, and how these materials are made can be known through chemistry.
	B. Stimulate thinking to solve problems (2,3)	Extent to which students' thinking is stimulated by chemistry problem solving	• The abstract nature of chemistry problem solving stimulates student's thinking.
	C. Active participation, satisfying one's own curiosity (4,5)	Extent to which students see the opportunity to actively involved in chemistry learning	• Students value group and active participation in chemistry as a way of satisfying student curiosity in chemistry.
B. Performance Goal and Chemistry Learning	**A.** Doing chemistry to attain good grades (6,7)	Extent to which students perform to get high grade attainment	• Students aim to obtain higher grades just for the sake of passing exams.
	B. Performance as an individual construct (8)	Extent to which performance is seen as depending on the individual learner	• Students view attaining higher grades as depending entirely on the individual learner and their choice of learning strategies.
	C. Self image of performance in view of others (9)	Extent to which performing a task is a measure of how well one performs against oneself	• A personal assessment on one's learning would enhance and promote a positive self-image which, in turn, would result in higher performance next time round.

Themes	Concepts (Question no)	Description	Comments
C. Achievement Goal and Chemistry Learning	**A.** Academic attainment as achievement goal (10) **B.** Problem solving & confidence as achievement goal (11,12) **C.** Applying content knowledge & sharing of ideas as achievement goal (13,14)	Extent to which students attain higher grades using effective strategies Extent to which students solve problems and gain confidence with content knowledge Extent to which students apply their content knowledge in real life situations	• Students' perceive that when they obtain higher grades in chemistry they achieve their goal. • Solving chemistry problems and gaining confidence in the content knowledge are seen as achievement. • Achievement is seen as the application of knowledge gained in chemistry to real life situation.
2. Attitude Toward learning Chemistry			
A. Student Attitude Toward Chemistry Lessons	**A.** Attitude toward Chemistry Lessons (15,16,17,18,23,24)	Extent to which students feel for their chemistry lessons	• Students attitude is shaped by the nature of teaching and learning strategies employed, lesson timings, the chemistry topics and their relevance to life.
B. Student Attitude and Practical Work	**A.** Attitude toward chemistry Practical work(21, 22)	Extent to which students value the importance of practical work in chemistry	• For better retention of chemistry content knowledge, practical skills and attitude, active learning which involves doing practical investigation and practical work is essential.
C. Student Attitude and Chemistry Learning	**A.** Attitude toward learning Chemistry (19,20)	Extent to which students' curiosity drives them to wanting to know more.	• Studying chemistry depends on students feeling for the subject and their choice of future career pathways. These drives student attitude.

Themes	Concepts (Question no)	Description	Comments
3. Self-Efficacy Toward Learning Chemistry			
A. Student Self-efficacy and Chemistry	**A.** Student level of Self efficacy toward learning chemistry (25,26,30)	Extent to which students approach chemistry with determination	• There is a low level of student determination to approach chemistry as a subject due to the compulsory and non flexibility nature of the curriculum – hindering students choice of a subject to study.
B. Academic Achievement and Self-efficacy	**A.** Academic achievement as a measure of attaining Self-efficacy toward learning chemistry (27,28,29,31)	Extent to which academic achievement enables students to have confidence to help others solve chemistry problems.	• Self-efficacy toward learning chemistry is seen as measured by an individual's academic achievement. The higher the achievement the higher the self-efficacy.
C. Intelligence and Self-efficacy	**A.** Intelligence as a measure of Self-efficacy toward learning chemistry (29,32)	Extent to which intelligence is viewed as a self-efficacy construct	• Intelligence is an antecedent to self-efficacy. Obtaining higher grades implies acquisition of higher self-efficacy. • Obtaining higher grades however, does not guarantee having confidence to perform a similar given task in the future.

4.2.3 Chemistry Learning Value

As noted above (Chapter 2), the degree to which students see the value and worth of knowledge to be acquired determines how much motivation and effort is placed in the learning process to acquire it (Reinke, Caraway, Tucker, & Hall, 2003).

A. Quantitative Data

The data in the Student Motivation, Attitude, and Self-Efficacy toward learning Chemistry (SMASEC) Cross-tabulation results (Table 4.3), suggests that the majority of Year 10 students in this study consider chemistry relevant to everyday life (1.71 mean for Chemistry Learning Value). The mean rating scale value is below 2 and that the cross-tabulation data also indicates that the majority of respondents strongly agree or agree with items 1 to 5. This suggests that most of the respondents value the importance of the chemistry content they have learned in their chemistry lessons. For example, for item 3, 81 percent of respondents (n=210) agreed that learning chemistry enables them to solve problems both in chemistry and in life. In addition, 41 percent of respondents strongly agree that they learn chemistry to solve problems. The data also show that for item 2, 86 percent of the respondents felt that learning chemistry does stimulate their thinking. Likewise, a total of 97 percent of respondents recognises the importance of active participation in chemistry, with 76 percent strongly agreeing (the highest percentage for the strongly agree scale) that participation in experimental activities and doing experimental activities is key in effective learning of chemistry (item 4). Furthermore, 83 percent of students say that they learn chemistry out of their own interest and curiosity (Item 5).

B. Qualitative Data

This section describes the interview conducted between the researcher and the Year 10 students in the focus groups. Each of the focus group interviews comprised 7–10 students randomly selected from those who completed the SMASEC instrument in each of the four schools. The two questions related to chemistry learning value are:

- How important is learning chemistry to you?
- How motivated are you in studying chemistry? (Appendix F)

The Year 10 students described here were given pseudonyms in order to protect their identities.

4.2.4 Importance of Learning Chemistry

In the focus group interviews strong emphasis placed on the view that students' learning in chemistry being worthwhile for the students' present and future lives. When the participants were asked "How important is learning chemistry to you?" they gave very interesting responses. One of the most common responses to this question centred on the advancement of technology and modernity, which the students felt calls for a deeper understanding of the nature of products and their chemical constituents and possible reactions. Gigs, for example, stated:

> It is important to learn chemistry because nowadays there are a lot of diseases coming our way … and also in our modern technological world, the use of aluminum for instance in airplanes, computers, chairs etc… are on the rise, and we need to know about how to extract aluminum from its ore using chemicals and this can only be done by learning chemistry.

It seems that learning chemistry aids these students, by stimulating their thinking. This is evident in the part of the interview that focused on the notion that doing chemistry problem solving activities enables students to develop their thinking skills. Allan, in response to this question, stated:

> Everything that happens around us happens with a cause. So by learning chemistry we can identify what causes things to happen in a certain way. Such a problem creates an avenue for careful thinking. Climate change, for example, is caused by something. Through chemistry we have learned that it was caused by green house gases, and therefore we need to reduce the emission of such gases as a solution for this problem.

Respondents also expressed support for the importance of doing practical experiments in chemistry. This, they felt, will enhance the retention of knowledge for a longer period of time, and enable students to develop certain scientific skills. Mari, in response to this, stated:

> When I think of chemistry I think of doing hands-on activities. Chemistry, to me, is all about doing experiments. Doing experiments help me to retain knowledge for a long time. That is why I think more emphasis should be placed on doing experiments as it effectively helps me learn chemistry more meaningfully.

4.2.5 Students' Motivation in Chemistry Learning

There were a variety of student responses provided in response to the question "How motivated are you in studying chemistry?" From the interviews, students indicated that they find their sources of motivation both intrinsically and extrinsically. The range of sources of motivation revealed in this study suggested that it begins within a person, and runs through the influence of its peers, friends, relatives, parents and teachers.

Some of the respondents indicated that they find motivation in their own lives or prior experiences. Gigs, for instance, stated that:

> To me, science in general and chemistry in particular is my most loved subject. I treat chemistry as I love it and that I do motivate myself to learn chemistry. This is because when I learn new knowledge in chemistry it encourages me to search for more new knowledge. This motivates me and makes me love chemistry.

Similarly, Josephine said "I am motivated to study chemistry because when I went to the clinics and hospitals I saw all this medicines and I am curious to find out what these medicines are made of."

Others found motivation in a desire to know more, that is, their motivation is extrinsic. Some students obtained motivation to study chemistry from their parents. Ben, for example, said “My parents are my source of motivation, since they both are university graduates with science majors.” Similarly, Jojo stated that, “My parents are the ones who motivate me to study chemistry. They are the ones who encouraged me to study chemistry.” Others reported that their siblings motivated them to study chemistry. Alla said, “I was motivated by my brother who is a medical doctor, who encourages me to study chemistry by explaining how things work in our body.” Others have also found motivation through their peers, as Geo stated: “In chemistry, I do find my motivation by seeing my friends doing their studies and obtaining good grades. This motivates me to do the same.”

In addition, there were those who had their motivation from a teacher, or as a result of academic achievement. Pat, for instance, stated that “My motivation lies with the teacher.” On the other hand, there are those whose motivation lies in the subject matter, and on specific chemistry topics. Randy, for example stated “I do not see my motivation in the teacher, but I believe my motivation is in the subject matter. If I am interested in the subject that will motivate me to study more.” Similarly, Sam said that she is motivated by less difficult topics in chemistry “For me, if the topic is difficult I would not be motivated to study it, but if it is easy I am motivated to study it.”

4.2.6 Students’ Performance Goal and Chemistry Learning

Performance oriented students are those who wish to achieve highly in external indicators of success, such as grades. Student performances can either increase a student’s intrinsic motivation if they perform well, but can decrease motivation when they perform badly (Ames, 1992). The performance goal result of the study is presented next.

A. Quantitative Data

There are inconsistencies in the respondents’ responses to the performance goal component of the survey. The mean value for the SMASEC performance goal component is 3.00. Most of the respondents (73%) said that they do chemistry to get good grades. From this it could be concluded that most students are performance oriented.

Performance goal here appears not to be related to other people's perception of an individual as a learner. While the data indicates a higher performance oriented populace for the surveyed population, in contrast, students do not think that they do chemistry so others think that they are smart (Item 8, 71% disagree). In addition, students do not think that they do chemistry to gain their teacher's attention (Item 9, 61% disagree). The data also revealed that students say that they do chemistry to be competitive within the classroom (Item 7, 46%). The data also suggests that students are interested in trying to get good grades (73% agreement, Item 6). While for the performance goal oriented student, praise and recognition are unavoidable associates for those who performed well, the data had shown that students do not see others' views on their performance as important.

B. Qualitative Data

This section describes the interview conducted between the researcher and Year 10 students in the focus groups. The question related to chemistry performance goals is:

- What is your reason for studying chemistry? (Appendix F)

A wide range of views were expressed when students were asked about their reasons for studying chemistry. A general sentiment was that chemistry is an important subject to study, but there were a variety of reasons given to support this. The students, for example, do not do chemistry to be seen by their peers as better scholars of the subject. Rather, those who do well are those who put more effort to studying the subject than their peers, and all have the potential to do well. As Su stated:

> We all have the same brain. We do not want to prove that we are smart, but those who perform well are those who study well. It is those who study well that are viewed as 'smart'. It's a bit weird to say that I am smarter than others, and that others do not know anything because we all have similar brains.

Others said that their reason for doing chemistry lies within a desire to learn more about the subject matter, rather than to be seen as smart by their peers. Loa, for instance, said:

> I do not do chemistry so others think that I am smart. My very reason for doing chemistry is so I could gain an understanding of the content and that am not of that type in which I want to show to others that I am smart.

Similarly, a focus on studying subject matter chemistry was expressed when students were asked if they do chemistry to gain their teacher's attention. The reasons students gave centred on the individual and the subject, with less emphasis placed on gaining their teacher's attention. As Stew observed:

> I do not do chemistry to gain my teacher's attention. But by doing so if it gains my teacher's attention that's good but if it does not, it does not matter. It comes down to the basis that it is all about me and my learning about chemistry that matters.

In addition, students commented on the effectiveness and importance of group work as a learning strategy, which they felt enables effective learning of chemistry. Students felt that effective and worthwhile learning took place within the social interactions students have with each other and their contributions to the group. This enables students to obtain an effective and worthwhile learning of chemistry. Stew, for instance, stated that "It is more vital and effective to work in groups because all of the participants are contributing towards the learning."

Students also observed that more understanding is gained by working in groups, and that this had a positive effect on individual performances in chemistry. Ju, for example, stated that:

> Working in groups in chemistry is good because if we are working as individuals some of the things we learn you won't be able to understand. Working as a group would enable each other to help each other learn because what you do not know your friend might know.

In addition, students observed that by working together they produce very effective answers to questions. As Oms said "Different ideas combined together make up a very good answer."

4.2.7 Students' Achievement Goal and Chemistry Learning

The degree to which students understand concepts, content, and the application of tasks can motivate them to attain higher grades. This would often result in students being motivated which would have effects on student achievement and performance (Bryan, Glynn & Kittleson, 2011). The study achievement goal findings are discussed next.

A. Quantitative Data

The findings indicate that students have a higher sense of achievement, with the rating scale score mean of 1.94 for the achievement component of the study. Students felt that they do achieve their goal in studying chemistry when they obtained good grades (Item 10, 85%). Moreover, students said that gaining confidence in the chemistry content is a mark of achieving their learning goals (Item 11, 84%). Students also said that in solving difficult chemistry problems, they have achieved their goal in studying chemistry (Item 12, 81%). This suggests that most students in the study value chemistry as a way of developing their problem solving skills. In addition, a positive sentiment over teachers' acceptance of one's idea as a means of achievement was expressed by the students (Item 13, 76%). Achievement here appears to be related to the teachers' acceptance of students' ideas – a sense of student fulfilment. Similarly, students said that the acceptance of one's idea by peers is an achievement goal in learning chemistry (Item 14, 66%). On the whole, while student achievement includes a teacher, peer and a student focus, it seemed to be heavily weighted on a personal construct, with an individual focus. As such, achievement is more intrinsically than extrinsically driven.

B. Qualitative Data

This section describes the interview conducted between the researcher and Year 10 students in the focus groups. The question related to chemistry achievement goals is:

- How do you know that you have achieved your goal in studying chemistry? (Appendix F)

Students expressed a wide variety of views on what it means to achieve one's goal in chemistry. It is apparent that students view achievement as a personal construct, rather than one that centres on others. It is, therefore, intrinsically student-centred. Some students said that achievement is an immediate measure of how well they understood and used the chemistry concepts learned to complete chemistry tasks. Ju, for example, stated that:

> I know that I have achieved my goal in studying chemistry when the teacher, for example, gave me exercises and I have done them correctly. I have achieved my goal by achieving knowledge of the content of chemistry in my head.

Other students said that achievement is a measure of how well they performed in unit and topic tests. Achievement, as such, is obtained through academic performance. As Su stated:

> I know if I have achieved my goal in chemistry when I receive feedback from my chemistry test and that I have scored a higher grade than my previous test. That, to me, indicates that I have achieved my goal in chemistry.

Likewise, Hely said that: "I could measure my achievement by how well I do in my current common topic tests in chemistry as compared to my previous test."

Another group of students viewed achievement as a measure of how well they apply the chemistry concepts learned in real life. It is an ongoing measure of how effective the chemistry content knowledge is applied and contextualized. Loa, for example, stated that:

> For me, I see my achievement in chemistry when I apply the knowledge I learn in class in everyday life and situations. For example, at home, whenever I was asked to do the dishes etc… I would look for the content of the cleaning agents and identify the different chemicals we learn in chemistry and say I know this chemical and its properties and how it can be used to clean out stains. By applying the knowledge and the chemicals to remove stains and clean up dishes, their effect is seen. When this happens I achieve my goal in understanding the chemistry and seeing its chemical effects.

Similarly, other students said that achievement is a measure of gaining unknown knowledge and understanding in class, through exams, and using it in different circumstances. As Ste said: "For me, I think I have achieved my goal in chemistry in three ways; by learning something from nowhere to somewhere, learning things through exams, and by applying the knowledge in different situations." Students here, therefore, have long and short term definitions of motivation (learning value, performance and achievement goals) for learning chemistry. Student attitude toward learning chemistry will be discussed next.

4.3 Students' Attitude Toward Learning Chemistry

The views that students hold on learning chemistry can either be positive or negative, and can affect their level of participation in learning (Dalgety, 2003; Neathery, 1997). Such a state of mind also influences both achievement and participation in science. The results of student attitude toward learning chemistry are presented below.

A. Quantitative Data

The 10 item attitude toward learning chemistry scale data shows quite a range, with the grand mean value of 2.2 and 21.51 for the scale mean for the attitude toward chemistry scale (Tables 4.2 & 4.3). Students say that, to them, finding out about things is very important, and this drives them to study chemistry (Item 20, 97%). The students also say that they have the desire to find out more about the world we live in (Item 19, 92%), and enjoy the activities they do in chemistry (Item 17, 76%). They are eager and look forward to attending chemistry lessons (Item 15, 72%), and do enjoy chemistry lessons (Item 21, 65%). They think that they should have more chemistry lessons each week (Item 23, 62%), and they love talking to friends about what they do in chemistry (Item 22, 68%).

The students also say that chemistry lessons are fun (Item 16, 45%), and that the chemistry done in Year 10 includes the most interesting things done at school (Item 18, 54%). Similarly, other students said that they feel satisfied after studying chemistry each week (Item 24, 54%). On the whole, while the students expressed a positive attitude toward learning chemistry, there are some who think otherwise and have a negative attitude toward learning chemistry.

B. Qualitative Data

This section describes the interview conducted between the researcher and Year 10 students in the focus groups. The question related to students' attitude toward learning chemistry is:

- What do you like or dislike about learning chemistry? (Appendix F)

There were a range of views expressed across all the schools and across all student participants about students' attitude toward learning chemistry.

4.3.1 Students' Attitude Toward Chemistry Lessons

Students' attitude toward chemistry lessons vary. Students from this study said that they do not like the passive learning strategies used by teachers in chemistry classes. This is because this does not actively involve students in learning chemistry. Joeli, for example, stated that: "I hate the reading of notes in chemistry. It makes me want to go to sleep. I want to do active instead of passive activities like experiments."

Other students say the 'chalk and talk' strategy used by some chemistry teachers rather than doing experiments affects students' attitude towards studying chemistry. Ju, for example, stated:

> Doing experiments is better than writing the chemicals on the board. That is one thing I like about chemistry because it deals with things in which we can observe in the lab. In our case here, most of the chemistry classes is conducted within the classroom and therefore on the black board.

Similarly, other students dislike chemistry because they do not see its usefulness and relevance in life. For instance, Hely commented: "I hate doing the balancing of chemical equations because it is confusing to me and that I do not see its relevance in real life situations."

Furthermore, some students said that they hate afternoon chemistry classes, those at the final period of the day which affects their concentration level, and therefore affects their attitude toward chemistry. Oms, for example, stated:

> I prefer to have chemistry lessons in the morning when my mind is fresh rather than at the last period of the day (period 8) in which I lose concentration and am [too] tired to do experiments and the exercise tasks given by the teacher.

4.3.2 Students' Attitude Toward Practical Work

Students from this study also stated that active participation in learning to improve and enhance better understanding and effective and worthwhile learning of chemistry is very important. This can be effectively achieved by doing practical work in chemistry in groups. Loa, for example, stated: "I like doing experiments because it involves hands on [work] and that I actively participate in the learning. The more I do the experiments the more I learn and understand."

Similarly, some students say that doing experiments in chemistry fosters the learning of the abstract chemical concepts. Chemistry to the students is all about doing experiments, and being actively involved in the chemistry learning process.

Joeli, for instance, stated “I like doing chemical experiments. When different chemicals are mixed to form new substances and seeing those changes is very interesting to me.” Likewise, Su stated: “I like experiments because you can see what is actually happening when new substances are formed in a chemical reaction.”

4.3.3 Students’ Attitude and Chemistry Learning

With regard to students’ attitude toward learning chemistry, some students said that they like doing chemistry because of its importance to their choice of future career pathways. Stew, for example, stated:

> What I really like about chemistry is that it is my goal to know more about it, the chemical reactions, balancing of chemical equations, because it will help me to understand about medicine because I want to be a medical doctor.

Some students, however, love dealing with topics in chemistry that deal with numbers and dislike chemistry nomenclature (i.e. the naming of chemicals). Su, for example, stated: “Chemistry to me is fun because it deals with numbers and that to me is nice, but I hate the naming of compounds and pronouncing the names of compounds.”

In addition, some students said that they disliked chemistry topics that involve calculations. For example, Loa stated: “I do not like balancing chemical equations because it deals with numbers and sometimes can get me confused.”

Having a positive outlook toward chemistry would encourage students to obtain a positive attitude toward learning chemistry. By doing so, students can convince themselves that they can successfully engage in the behaviour required to produce good learning outcomes.

4.4 Students' Self-Efficacy Toward Learning Chemistry

The belief a person has in his/her capability to organise, and execute a required cause of action to produce a given attainment is an antecedent of behavioural change (Bandura, 1986; Gerhardt & Brown, 2006; Jinks & Morgan, 2001; Yusuf, 2011). Thus, the degree of failure or success by which an individual performance is measured determines future attempts to complete tasks of similar nature. Failure in a given task reduces self-efficacy while success increases self-efficacy. The self-efficacy result of the study is presented next.

A. Quantitative Data

The self-efficacy grand mean data was 2.7, and scale mean was 21.41 (Table 4.2). This implies that most students have low self-efficacy toward learning chemistry. Student self-efficacy, therefore, falls within a tighter range favouring a higher value of the rating scale. The students said that they had to work hard to pass chemistry - an indicator of low self-efficacy (Item 30, 95%). It is worth noting here that out of the 95 percent, 69 percent strongly agree that they need to work hard to pass chemistry. This is the second highest percentage within the strongly agree response for the entire study. Students also have a wide range of views regarding how easy it is to get good grades in chemistry (Item 25, 41% agree and 26% disagree). Interestingly, the students said that despite their low self-efficacy, they saw themselves as intelligent (Item 31, 47%). Similarly, students also said that they do help their peers whenever they need help with their school work (Item 27, 47%). In addition, students said they provide assistance in helping their friends with their homework (Item 32, 43% agree and 23% disagree), and felt that they are good at chemistry (Item26, 40% agree and 27% disagree).

On the other hand, more disagreement within the self-efficacy component was seen for Items 28 and 29. The students said that they find chemistry to be not as easy as expected (Item 28, 39% disagree and 31% agree), and they do not perform better than their classmates (Item 29, 38%). As indicated above, the rating scale score data is evenly distributed throughout self-efficacy Items 25 – 32. This consistency in data indicates that the class of students, although they have low self-efficacy, have other factors which contributed to their behavioural intentions.

B. Qualitative Data

This section describes the interview conducted between the researcher and Year 10 students in the focus groups. The question related to students' self-efficacy toward learning chemistry is:

- Do you think you are good in chemistry? (Appendix F)

The students expressed a range of views about how well they do in chemistry.

4.4.1 Students' Self-Efficacy and Chemistry

From the quantitative data, it is apparent that the level of students' self-efficacy is quite low. Some students also say that the reason they feel like this rests in the individual characteristic of students, and how they view themselves. For example, Ju noted: "I, for one, do not normally ask others for help. Not that I know everything, but because I am shy to ask others for help. I believe if I study well, I should be good in chemistry."

Similarly, Oms stated: "No one came to me and ask me a question as yet. I have a lot of questions to ask but I am very shy to do so."

Other students also commented that their parents play a major influential role by encouraging them to study chemistry. Some students said that the effect of such an influence on their self-efficacy in chemistry is yet to be seen. Nina, for example, stated: "I am not good in chemistry but my parents are the ones helping me out with chemistry since both of them are university majors in science. My parents also motivate me to do and study chemistry."

Likewise, Hely commented:

> I do not really do well in chemistry as compared to physics and biology. I am not that good in chemistry. Sometimes I go and ask

> others. I did not recall any time that my peers came and ask me for help. In class, I do not ask my peers questions but I am not afraid to ask the teacher.

4.4.2 Academic Achievement and Self-Efficacy

Some students say that they are being asked for help quite often as far as they can remember. This is because they were seen as higher achievers of chemistry by their peers. Cecil, for example, stated:

> I think I am good in chemistry. I have some of my friends came to seek assistance from me on a number of occasions. I only help them when I know how to answer their queries and ask them to see the teacher if we together do not know and understand the problem. I sometimes ask the teacher to help me when I do not understand.

Some students noted that they often seek a helping hand from their family members, who they think are knowledgeable about chemistry. Loa, for example, stated: "I do not often ask individual questions to the teacher. I somehow ask questions to my other peers whenever I have problems especially my elder brother because he is good in chemistry." The students said that they have the potential to excel if they put more effort and commitment into their chemistry learning.

4.4.3 Intelligence and Self-Efficacy

On the other hand, there were some students who said that they are intelligent and have a high level of self-efficacy toward chemistry. Intelligence here is measured in terms of an individuals' ability to think and learn. Stew, for example, stated:

> Chemistry is my best subject because I live and [am] surrounded by people, my peers, brothers and sisters who do chemistry, at home. I think that I am good at chemistry because I obtain higher grades in chemistry. My friends in class come to me often whenever they need help in chemistry. I rarely asked my friends for help in doing chemistry.

The data above suggests the level of student self-efficacy toward learning chemistry determines student motivation and attitude in learning chemistry. Having a positive attitude focus with higher motivation toward learning chemistry, would produce higher self-efficacy toward learning chemistry.

4.5 Summary

The results of both the quantitative (SMASEC Questionnaire) and qualitative (focus group interview) data collected indicates an association between student motivation and student attitude toward learning chemistry. As was presented in this chapter, student motivation toward learning chemistry has a wider range of sources from student peers, teachers, parents, to siblings. The research findings suggested that Year 10 students place a high degree of importance on the learning value of chemistry. More importantly, it seems that intrinsic motivation as a personal construct drives students to pursue the study of chemistry. In addition, the students' performance goal centres on the individual as a person learning in a socially constructed environment drawing upon peers to achieve their chemistry academic goals. Both performance and achievement goals in this study appear not to be related to other people's perception of an individual as a learner. On the whole, while student performance and achievement goals include a teacher, peer and a student focus, they are both believed to be heavily weighted on a personal construct, and individually focused. As such, both performance and achievement goals are more intrinsically than extrinsically driven.

The study has also suggested, however, that with the highly motivated researched population observed, there is little evidence that such motivation toward studying chemistry reflected their attitude toward learning chemistry. On the whole, students' attitude toward learning chemistry is shaped by teachers, learning environments, self-concept, peers and parental influence. This is consistent with previous studies (e.g., George & Kaplan, 1998; Keeves & Alagumalai, 1998; Lin, 1998). Similarly, students' self-efficacy toward learning chemistry is low, suggesting that student motivation and attitude has an influence on student self-efficacy toward learning chemistry, and vice versa.

Further discussions of the main findings and their significance are the focus of the next chapter, Chapter 5.

CHAPTER 5: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

The purpose of this chapter is to discuss the research findings presented in Chapter 4, and to draw conclusions from these findings. This chapter begins with a discussion of the research findings for each of the research questions. Following from this are the implications of the findings from this research. Next is a discussion on the limitations of the research, followed by some recommendations for future research. This chapter ends with some concluding thoughts.

This thesis has culminated in the presentation of findings about students' perceptions of their motivation (Chemistry Learning Value; Performance Goal; and Achievement Goal), attitude and self-efficacy toward learning chemistry. Year 10 students from four secondary schools completed the *Student Motivation, Attitude and Self-Efficacy toward learning Chemistry* (SMASEC) questionnaire. The SMASEC sought to obtain information about students' motivation, attitude and self-efficacy in learning chemistry and was validated for use in secondary school in classrooms through a pilot study. Associations were investigated qualitatively between aspects of the SMASEC to help understand students' motivation, attitude and self-efficacy toward learning chemistry. This research for the first time presents qualitative evidence from the SMASEC about factors that may influence Year 10 students' behaviour toward learning chemistry. Qualitative comparisons of the sources of motivations, attitude and self-efficacy as perceived by students, suggest that students are more interested in contextual chemistry and activities that engage them throughout their learning.

The study seeks to make both students and teachers of chemistry aware of students' perceptions of motivation, attitude, and self-efficacy when learning chemistry. Such research provides data which teacher educators, teachers, and curriculum developers of chemistry can reflect upon and consider ways in which they can re-think, re-direct and challenge students' motivation, attitude, and self-efficacy in learning chemistry. This study thus identifies viable ways for chemistry teachers to effectively manage their classroom environment. From this research, it is hoped that teachers, peers and parents of students can enable enthusiasm for chemistry. The research also provides insights into students' reasoning and allows interpretation of data obtained from the SMASEC questionnaire. The focus group interviews allowed students to describe their impressions of their teachers, and explain their own behaviour.

From this research, student self-efficacy beliefs about chemistry learning seem to affect students' level of motivation to perform and achieve, and their attitude toward learning chemistry. Such findings are substantiated by other researchers, who reported that individuals with low self-efficacy hold negative thoughts, which then influence their level of anxiety, resulting in lower motivation to perform and achieve (Entwistle et al., 1974; Sirhan, 2007; Reid, 2007; Vedder-Weiss & Fortus, 2011). Such individuals tend to focus on their lack of ability to cope in situations of potential threat, and this can hinder their motivation to achieve. It was also reported by other researchers that having motivation to learn is an antecedent of successful learning (Armitage, 2008; Martin & Dowson, 2009; McInerney & Van Etten, 2004; Sirhan, 2007). The research findings in the present work indicate that students are intrinsically motivated to learn chemistry. However, their success in learning is somewhat predestined by a lack of positive attitude and self-efficacy toward learning chemistry. It is also reported that "teachers face problems when their students do not all have the motivation to seek to understand, and thus have a negative effect on their attitude towards learning" (Dalgety, 2003). It seems that students are well aware of the influence of the nature of teaching chemistry as seen demonstrated here by their teachers, and their own ability to learn. This gap may be a hindrance toward students having motivation, a positive attitude, and self-efficacy toward learning chemistry. Next to be discussed are the major findings of this study.

5.2 Major Findings of the Study

The main purpose of this research is to understand Year 10 students' perceptions about their motivation, attitude and self-efficacy toward while learning chemistry, and to identify factors that may have helped or hindered student learning of chemistry. Research on student motivation, attitude, and self-efficacy suggests that prior beliefs can change with new information presented within students' current beliefs, attitude, and experiences (Areepattamannil et al., 2011; Bandura & Locke, 2003; Bannier, 2010; Britner, 2008; Dalgety, 2003; Reid, 2007). The study findings here highlight that to change an individual's attitude, the teaching of chemistry must be seen by them as worthwhile, and related to the individual's own beliefs and attitudes. The research questions presented in Chapter 1 are now considered here.

5.2.1 Student Motivation Toward Learning Chemistry

The first research question that this study explores is:

> What motivates students to study chemistry?

Motivation here is defined as having a desire and energy to be continually interested in and committed to exert persistent effort in attaining a goal (Areepattamannil et al., 2011; Bannier, 2010; Benton, 2010). The three areas of motivation that are addressed in the SMASEC, Chemistry Learning Value, Performance, and Achievement Goals, indicates that students' motivation was influenced by their perception of themselves as learners, the process of learning - how they learn - and the influence others have on their learning. The research findings also identify similar motivational patterns to those reported in the literature (e.g., Dalgety, 2003; Martin, 2003; Reid, 2007; Weiner, 1990).

Firstly, the students say that their need to achieve motivates them to pursue learning chemistry. As such, students strive to attain higher grades. Such students are said to be performance goal oriented (Ames, 1992; Covington, 1984; Dweck & Ellen, 1988; Gage & Berliner, 1979; Martin, 2003). In particular, the students view gaining higher achievement as a prerequisite of achieving personal growth.

This is similar to other research findings conducted by Simpson and Oliver (1990), and Vedder-Weiss & Fortus (2011), who say that this perspective is behavioural with emphasis placed on incentives and reinforcement.

Secondly, the findings indicate that students view their choice of career as an antecedent for their need to achieve, and that they are thereby motivated intrinsically. Intrinsic motivation refers to behaviours performed out of interest and enjoyment (Ryan & Deci, 2000). In contrast, extrinsic motivation refers to behaviours carried out to attain contingent outcomes (Ryan & Deci, 2000). For example, whereas learning science for its own sake is intrinsic motivation, to learn science for the purpose of passing exams is extrinsic (Eccles et al., 2006).

Thirdly, the research findings also suggest that students' desire to obtain knowledge about chemistry motivates them to study chemistry, in particular, students' desire to obtain knowledge about either difficult medical situation faced by members of their families, or by their self-interest to discover the environment by interacting with others. Students with such a genuine interest in acquiring a better knowledge are said to be pursuing learning goals (Ames, 1992; Dweck & Ellen, 1988; Martin, 2003). Motivation to these students is rooted in the basic need to minimize physical pain, with the intention to maximize pleasure and thus it is intrinsically driven (Areepattamannil et al., 2011; Bannier, 2010; Benton, 2010). In addition, students say that they prefer doing, and obtaining knowledge through individual, meaningful tasks as a measure of achievement, instead of a searching for satisfaction through socialization – in contrast with other research (e.g., Dalgety 2003; Reid, 2007; Weiner, 1990). The motivational focus, as seen here, centres on the individual and is one way of interpreting and constructing knowledge based on past environmental and situational experiences (Raina, 2011; Sesen & Tarhan, 2010).

Finally, it was found in this study that students gained motivation for learning chemistry by having a feeling of responsibility imposed by their peers and parents. This is what is referred to by other authors as a motivational influence on subjective norms (Dalgety & Coll, 2004; George & Kaplan, 1997; Schunk, Pintrich, & Meece, 2008; Vedder-Weiss & Fortus, 2011; Woolnough, 1994). In particular, students are internally aroused by external factors that affect the environment and their natural surroundings. This is consistent with other research and studies conducted – which argue that these external factors in turn lead to student action (e.g., Connell, 1990; Connell & Spencer, 1994; Connell & Wellborn, 1991; Tucker et al., 2003; Weihuru & Williams, 2010).

5.2.2 Student Motivational Inhibitors in Chemistry

The second research question that this study explores is:

> What inhibits students' motivation toward studying chemistry?

The findings from this study suggest that students' motivation (Chemistry Learning Value; Performance Goal; and Achievement Goal) toward learning chemistry can be inhibited by several factors. Firstly, the students say that the passive teaching strategies employed by teachers of chemistry such as the chalk-and-talk, teacher-centred approach, inhibits their motivation to study chemistry. Chemistry, according to the students, is about doing and being engaged actively in learning. Learning within the Solomon Islands culture occurs in a socio-cultural setting in which the young learn from their seniors and elders by actively doing what the elders practically demonstrate. Skilled experts demonstrate the desired behaviour by teaching the essential know how and skill through word of mouth, and by doing (Valence, 2007, 2008; Geogeo & Geogeo, 2002). Learning here occurs through observing others' behaviour, attitudes and outcomes of those behaviours and by doing – consistent with other findings (e.g., Bandura & Locke, 2004; Schunk, 1995). Thus students' prefer to carry out experiments and expressed their enjoyment in the stress-free learning atmosphere such an environment promotes.

Secondly, students say that the teaching of chemistry abstract concepts should be contextualized, so students can easily visualise the concepts and understand. Seeing chemistry concepts as foreign to them hinders students from seeing the worth of what they learned - consistent with other research findings (e.g., Sade & Coll, 2003).

Thirdly, the students felt that the allocation of class times for chemistry is essential for motivation of students. Students' say they prefer chemistry classes that are held in the morning compared to those held in the afternoon. The reason for this is students are fresh in the morning and much more attentive than later in the day when they are tired and lose concentration. Less cognitively demanding subjects such as physical education could perhaps be taught later in the day.

Finally, students said that another inhibiter to their motivation centres on themselves; their interests, views, and previous experiences with similar topics. When students view topics as difficult, they are not motivated to pursue their studies. This is consistent with the literature which stipulates that the belief in oneself determines one's functioning as a human being (Bandura, 1986; Bannier, 2010; Battle, 1966).

5.2.3 Student Attitude Toward Learning Chemistry

The third research question that this study explores is:

> What are students' attitudes toward studying chemistry?

The research findings in this study also revealed that the imaginary construct that represents students' degree of like or dislike for chemistry, varies. Similarly to other studies conducted to measure attitude, the results here revealed that attitude is either a result of direct experience or observational learning from the environment (Dalgety, 2003; McGurie, 1989). Firstly, the students' attitude-toward-chemistry as measured by the survey, unlike previous work by Dalgety (2003) on university science and engineering students who choose to do further studies, revealed a negative attitude toward chemistry. The results here revealed that, while the students saw the importance of acquiring a holistic chemistry understanding for life, their attitude was still negative. The reasoning for such behaviour is clear from the qualitative data. The resentment shown here by students seems to have its origin in students' past learning experiences of chemistry. The students say that most of their teachers teach chemistry in class without practical work. In the context of Solomon Islands, and of some of the schools in which this research is carried out, the lack of doing laboratory work is due to a lack of proper laboratories, not enough proper scientific apparatus and reagents, and a lack of effective planning by teachers in schools with fully equipped and proper laboratories. This is consistent with findings reported in previous studies in the Solomon Islands (Giano, 2010; Kakai, 2009).

Secondly, the results indicate that students' attitude toward chemistry can be stimulated by how the chemistry lessons are presented. The willingness of students to participate in the learning process, according to this study, lies in the teacher's interpersonal behaviour, the teaching and learning process, and the environment. The ways teachers conduct themselves in class, their choice of teaching and learning strategies, and the learning environment has a significant impact on students' attitudes. Such attitudes, whether positive or negative, derived from experience, shapes the behaviour of students in the classroom. This is consistent with previous studies (e.g., Brekelmans, Wubbels, & Levy, 1993; Fraser & Welberg, 1991; Hong, 2010; Reid, 2007). While these studies were for general attitude toward science, this research also finds a similar case in students' attitude toward learning chemistry. Koballa (1988b) and Reid (2007) say that learning outcomes subject to affective variables as much as they are to cognitive variables. Interestingly, the participants here expressed a desire to have fun in their chemistry lessons, which in turn might encourage involvement and result in a positive attitude toward learning chemistry.

Thirdly, parents have a pivotal role in influencing students' attitude toward learning chemistry. The majority of students in this study said that their parents were supportive of their study of chemistry. While some research suggests that the home background is unrelated to student attitude (e.g., Schibeci, 1989), this study seems to suggest that it is related to student attitude toward learning chemistry. Students say that their positive attitude toward learning chemistry at high school is because their parents are science graduates, and they encouraged them to study chemistry. The help such parents rendered to their children, assisting them with their chemistry home work and promotion of chemistry related activities at home is influential on students' attitude toward learning chemistry – consistent with other studies (e.g., Crawley & Black, 1992; Jones & Young, 1995; Jarvis & Pell, 2002). Unlike these studies which see a decline in the response to parental attitudes in secondary schools, students in the Solomon Islands are more likely to be influenced by parental opinion, regardless of gender. This is attributed to the respect that such a society has for parents and the elderly generally.

Finally, peers influence student attitude toward learning chemistry. There appears to be a stronger relationship between student perceptions of peer influence and peer attitude toward learning chemistry. For example, both positive peer influence and positive attitude toward learning chemistry are said to influence higher achievements in chemistry. The participants noted that the influence their high achieving peers had on their attitude toward learning chemistry encouraged them to strive to attain higher grades. While other research suggests a tenuous relationship between peer attitude and student attitude (e.g., Dalgety 2003), this study found that there seems to be a degree of peer attitude influence on student attitude. Students form peer groupings within their year level that reinforce their interest and need to achieve higher grades in chemistry. Such an association as seen amongst Year 10 students results in changing students' attitude toward learning chemistry, and the way they view learning chemistry as a subject – consistent with other research findings (e.g., Gogolin & Swartz, 1992; Talton & Simpson, 1985).

5.2.4 Student Self-Efficacy Toward Learning Chemistry

The fourth research question that this study explores is:

> What is students' self-efficacy toward learning chemistry?

Another area of interest in this study is student self-efficacy toward learning chemistry. Self-efficacy here is the conviction and belief that one can successfully execute the behaviour required to produce an outcome (Bandura, 1986; Gerhardt & Brown, 2006; Jinks & Morgan, 2001; Weihua & Williams, 2010). There have been many studies conducted since Albert Bandura introduced the idea in 1976. This research, however, was directed specifically to Year 10 students and their quantitative data (Table 4.1, 4.2, & 4.3) points to low self-efficacy toward learning chemistry. The underlying reason for such findings was identified through the qualitative data. The consistency in the quantitative and qualitative data indicates that the students, although they have low self-efficacy, have reported other variables which contribute to such behaviour. The first reason expressed by students seems to be a lack of a high level of self-belief. A contributing factor toward such a belief rests in the different student background and upbringing which had an impact on students' physical and emotional state. Most students in the Solomon Islands are not confident about speaking out and challenging their elders and the views of people in authority. This is influential in the manifestation of the low level of self-efficacy toward learning chemistry observed in this study. The typical home environment in Solomon Islands is one in which children are reserved, told not to fully express themselves in front of their parents, with fear seen as a mark of respect. Such a notion as seen in students' response in this study depicts students experiencing self-doubt and anxiety. This is consistent with literature which suggests that the more students hold high self-efficacy, the more they have open communication with their parents, and elders (Caparara, Pastorelli, Regalia, Scabini & Bandura, 2005; Reid, 2007). It is, therefore, understandable that the higher students develop their self-efficacy at home, the more likely they are to develop a positive level of self-efficacy at school.

Secondly, students said that their past learning performance of repeated failure in chemistry tasks creates a certain lack of belief in themselves. This created fear of repeating earlier failures, causing students to avoid performing similar tasks. Such finding is related to Bandura's performance attainment, which is interpreted as an authentic mastery experience of one's performance (Bandura, 1986; Stajkovic & Luthans, 1998b). Thus, a strong efficacious belief is formed when a person experiences success, while repeated failures lower self-efficacy. Thus, in this case, previous student experiences help create a low level of self-belief in the students.

Thirdly, the fear of imitating and comparing a student's behaviour to others behaviour in performing a task is seen as degrading a student's learning and thinking status. According to Bandura (1986), a student visualising and comparing themselves with other students' successful performance of a task can raise self-efficacy. While this type of comparison enables students to model their level of self-efficacy against their peers of similar academic level (Bandura, 1986;

Stajkovic & Luthans, 1998b), the findings here indicate great reluctance in students to do so, due to personal pride and respect for high competency displayed by their peers.

Finally, the participants say that there is very little verbal encouragement amongst the students, and from their teachers. Verbal persuasion is believed to determine self-efficacy (Bandura, 1986; Gerhardt & Brown, 2006; Stajkovic & Luthans, 1998b). The participants expressed the view that most teachers give praise only where praise is due, and that the competitive nature of student peers caused students to be reserved, and not be vocal. In addition, participants' upbringing in terms of respect for the teacher (elders and those in authority) during class time has also shaped students to be introverts during lessons, directing their feelings and thoughts inwardly.

5.2.5 Student Motivation and Attitude Toward Learning Chemistry

The fifth research question that this study explores is:

> What association, if any, is there between students' motivation and their attitude toward learning chemistry?

The influence, if any, of students' motivation on students' attitude and self-efficacy toward learning chemistry was investigated by examination of the qualitative data. These data were used to see whether students identified any relationship between motivation, attitude and self-efficacy toward learning chemistry.

The findings suggest that there is a relationship between students' motivation and their attitude toward learning chemistry. Motivated students have a positive attitude toward learning chemistry. Students' curiosity and desire to achieve motivates them to have a positive attitude toward learning chemistry. This helps students set higher, achievable, goals that can be achieved with a positive change of attitude. Achieving such goals encourages students by creating a desire to know more about the subject. Such findings are consistent with the literature (e.g., George & Kaplain, 1998; Hardre, Sullivan & Crowson, 2009; Hong, 2010; Reid, 2007; Yusuf, 2011). In addition, students are motivated when they see the worth of the chemistry knowledge acquisition, and they then have interest to pursue study. This is consistent with other work (e.g., Keeves & Alagumalai, 1998; Reid, 2007; Tuan et al., 2005; Walker & Greene, 2009), in which it is reported that the values related to science have clearly recognizable influence on both science achievement and participation and in career choice. Similarly, this study found this to be the case for students' motivation and attitude toward learning chemistry. In addition, students' attitude also influences both achievement and participation in chemistry.

5.2.6 Student Motivation and Self-Efficacy Toward Learning Chemistry

The sixth and final research question that this study explores is:

> What association, if any, is there between student motivation, and self-efficacy toward learning chemistry?

As previously described in this study in relation to motivation theory, goal setting and self-efficacy are influential on students' expectations and achievement (Jinks & Lorsbach, 2003; Pajares, 1996; Reid, 2007; Tuan et al., 2005; Yusuf, 2011). The qualitative findings indicate that students' motivation had a direct influence on their self-efficacy toward learning chemistry. Students who are intrinsically motivated to study chemistry have acquired a sense of self-worth and confidence, setting goals that they can achieve and working towards achieving them. Such students are then performance oriented. This study also found that intrinsically motivated students are more outspoken and expressed enjoyment and excitement about acquiring knowledge and the sense of accomplishment it brings. This is consistent with previous studies (e.g., Barrick, Mount & Judge, 2001; Costa, McCrae & Martin, 2008; Hong & Lin, 2011; Martin, 2003; Weiner, 1990) in which it was reported that extraverts tend to be talkative, assertive and experience affects such as energy, zeal, and excitement. From this study, students that are motivated, and have high self-efficacy toward learning chemistry, often confidently share their knowledge with others, as compared with those who have less motivation and low self-efficacy.

The study also highlighted that student motivation and self-efficacy toward learning chemistry can be enhanced by doing more practical work – consistent with other research findings (e.g., Manaf & Subramaniam, 2004; Staver, 2007; Sterling & Frazer, 2008; Yusuf, 2011). In addition, students are motivated when the practical and investigative work is designed and carried out within the student context and environment (Brodie, 2006; Roscorla, 2009; Woodley, 2009; Yagenska, 2007; Zain et al., 2010). Such an engagement builds student confidence and aids the retention of knowledge and understanding of concepts in chemistry. This, in turn, will build student self-efficacy toward learning chemistry.

In summary, with data obtained from both the quantitative and qualitative analysis, valuable feedback from student perceptions on their motivation, attitude, and self-efficacy toward learning chemistry were obtained. Next to be discussed are the implications of the study.

5.3 Implications of the Study

The implications of this study are likely to be of interest to teachers, curriculum developers, and teacher educators, and it is hoped that the findings provide valuable feedback about student motivation, attitude and self-efficacy toward learning chemistry.

5.3.1 Validation of SMASEC

By creating awareness of the significance of the chemistry classroom environment with the use of the SMASEC instrument, this study presented its validation for use in schools. Chemistry teachers, therefore, have an opportunity to access this instrument with confidence in order to identify and understand the type of motivation, attitude, and self-efficacy conditions that either promote or hinder the learning of chemistry among such similar school aged students. This study demonstrates that students were very responsive to learning environments that are conducive toward promoting student motivation, positive attitude and higher self-efficacy toward learning chemistry.

5.3.2 Socio–cultural Influence and Chemistry Teaching and Learning

In addition, teachers need to be aware of the cultural influences that are associated with Solomon Island culture and any other similar cultures, which have this notion of respect and not challenging elders. It is likely to be beyond a teacher to change such notions, and indeed it is not necessarily appropriate that they should attempt to do so. However, what a teacher can do is to encourage students to understand that in the learning environment, such as schools, it is acceptable to challenge and to speak out and clarify things. With such continual encouragement, students would be expected to develop a higher level of motivation and self-efficacy with a positive attitude toward learning chemistry.

5.3.3 Quantitative and Qualitative Feedback to Curriculum Developers, Teacher Educators, Teachers, and Students

The collation of both quantitative and qualitative data specific to this study provides insights to teachers, students, teacher trainers and curriculum developers who might wish to reflect on how learning within a chemistry Year 10 classroom can be understood in terms of student motivation, attitude and self-efficacy.

5.3.4 Bridging the Chemistry Teaching and Learning Gap

The findings presented here can be used as a reference point to bridge the teaching and learning gap that exists within the chemistry teaching and learning process, and to establish a better understanding of the chemistry classroom environment. For instance, the demand to effectively carry out practical work by students of chemistry identified as a learning gap can be addressed by chemistry teachers. This can be done by implementing laboratory exercises to ensure the development of skills, attitude and the effective acquisition and retention of content knowledge by all students. Such practical work can be done by improvisation of the school surroundings as an outdoor laboratory. With careful planning, implementation, and an increase in the frequency of such practical tasks, worthwhile learning could take place, bridging the chemistry contextual teaching and learning gap.

5.3.5 Reference Point for Curriculum Developers

This study could also act as a reference point in which curriculum developers of chemistry can reflect as they design their chemistry curriculum at each year level ensuring that contextualised chemistry learning is taking place. The chemistry curriculum envisioned is one in which the common Solomon Islands daily experiences, which involve chemical principles and concepts, be incorporated into the teaching and learning of chemistry. These should be designed into improvised contextualised learning experiences and experiments within the Natural and Processed Materials (NPM) strand of the Solomon Islands National Science Curriculum (SINSC). The intention is to ensure that such conceptual learning and experimental work be done by chemistry students throughout the entire country, even in remote locations with minimum resources.

5.3.6 Teacher Educators and Chemistry Teachers

For teacher educators, this is a worthy resource for reflection upon how teachers of chemistry should be trained to address teacher and student behaviour that is deemed unsuitable for encouraging learning in chemistry classrooms. Another reason to use this instrument in chemistry classrooms would be to evaluate the impact the current chemistry NPM strand within the Solomon Islands curriculum and teaching strategies used have on student motivation, attitude and self-efficacy toward learning chemistry. In addition, the School of Education (SOE) at Solomon Islands College of Higher Education (SICHE), and similar training institutions under their science teacher educator programmes, could develop and strengthen an improvised contextualised module which will engage and equip science teachers with the skill and knowledge required to effectively teach chemistry with and without much equipment in the Solomon Islands. Such programmes could be reviewed based on the administration of SINSC. Furthermore, a policy should be developed which stipulates clearly the minimum chemistry teacher skill entry requirement prior to entering the teaching profession.

Such a benchmark could enable teachers of chemistry with the ability to teach contextual chemistry, even in remote school settings, to a certain level. This notion can be extended to include other science subjects such as Biology, Physics, and the Earth Sciences.

5.3.7 Chemistry Students

This study concluded that students are intrinsically motivated to study chemistry. However, the study also revealed that students also have negative attitudes, and low self-efficacy toward learning chemistry. These are contributing factors for students not enjoying learning chemistry. Students should, therefore, be encouraged to make personal reflections on their motivation, attitude, and self-efficacy when learning chemistry, make improvements where appropriate, and take necessary actions that foster effective and worthwhile learning of chemistry. By doing so, students could use their school chemistry knowledge to try to make sense of the natural world around them. This can be done by ensuring that all students have personal journal entries on their motivation, attitude and self-efficacy in learning chemistry each week. Students are then required to assess their own learning progress each week, submit a one page summary of their reflections to both the teacher and peers and commit to improving their motivation, attitude and self-efficacy in learning chemistry. Furthermore, Year 10 students should be given a bridging unit on the basics of mathematical chemistry at the beginning of the chemistry unit. This would include calculations such as dilution, mole, and relative molecular mass calculation exercises. To help boost students' motivation and self-efficacy, worked problem exercises should be hierarchically designed from simple to challenging problems

5.3.8 Teacher Professional Development

Teacher professional development needs to consider how to create an effective chemistry learning environment that best suits the different topics of chemistry. In particular, in-service opportunities could be provided that address strategies on how to increase the level of student motivation, attitude, and self-efficacy in learning chemistry. Teachers could adopt contextual lesson planning that utilizes specific strategies such as student focus discovery and cooperative learning that promotes a positive learning environment for chemistry. Such lesson planning should incorporate a certain degree of flexibility to allow for the different learning needs of students in order for them to develop a sense of ownership toward learning. This can be done by allowing and guiding students to develop their own experimental designs for given chemistry topics, with inquiry prompts guided by the teacher. This could raise motivation, attitude, and self-efficacy in regard to learning chemistry.

5.3.9 Experiments and Chemistry Learning

The research findings have also revealed students' desire for more experiments and practical work to be incorporated into chemistry lessons. Teachers need to extend the learning environment beyond what is stipulated in the curriculum and its supporting resources. This can be done by contextualising adopted experiments to suit student contexts. Doing experiments does not have to be in the classroom or science laboratory. This could be done by identifying student common life experiences that involve chemistry principles and concepts (Giano, 2010; Kaikai, 2009). This is illustrated by the use of a candle to teach "the chemistry of the burning candle" which involves concepts such as melting, evaporation, condensation and so on, or 'the disappearing water' investigative study to study the evaporation of water. Experiments help students see the application of theory, enhance enjoyment, and develop a better understanding of chemical concepts learned. Such learning environments and situations, when effectively planned and implemented, are conducive to learning, and would foster worthwhile learning, resulting in respect for the teacher by students. The idea that students' sense of autonomy and control over their academic activities promotes students motivation to engage in such activities is supported by various authors (e.g., Assor, Kaplan, Kanat-Maymon & Roth, 2005; Deci & Ryan, 1987; Patrick, Skinner & Connell, 1993; Skinner & Belmont, 1993; Vedder-Weiss & Fortus, 2011). In this way, students may develop positive attitudes toward learning, be more motivated, and gain greater self-efficacy toward learning chemistry. The limitations of the study will be discussed next.

5.4 Limitations of the Study

Although the findings reported here validate the SMASEC, there are some limitations that were faced while conducting this study. Such limitations should be addressed if such similar studies are to be conducted by others.

5.4.1 Limited Funds

This study was conducted only within an urban setting. This was due to the limited funds available for the study. The sample size, however, is assumed to be fairly representative of school population within Solomon Islands. It would be interesting to conduct a similar study within all urban and provincial private and state-owned schools and make comparisons.

5.4.2 Level of Year 10 Teacher Education

A second limitation to this particular research was that the teachers teaching at Year 10 chemistry have different levels of academic education, two hold Diplomas in Teaching Science (DTS), after completing Year 13, and others are university graduates majoring in chemistry. Most of the teachers who obtained their first degree from university are not trained teachers, but have obtained a Bachelor in pure science (BSc). This has a real influence on the strategies employed by the teachers, which may have contributed to the students' feedback in this research.

5.4.3 Time Constraints

Another limitation was that, due to time constraints, one school interview was held out of school hours. This contributed to the students giving feedback that might influence their honest opinions. In other settings, there were some who were short listed but were replaced by other available students who completed the survey questionnaire. This might have an influence on the student replacement for the interview by increasing their anxiety, thus affecting their feedback during the interviews.

5.4.4 Interview Venue

Another limitation is due to the interview venues. There were a number of disturbances with students walking around and it might have been better to have the interviews in a closed room where there would be no disturbance from other students and teachers.

5.5 Suggestions for Further Research

This study has alerted chemistry students to the manner in which they perceive their learning of chemistry to have occurred with respect to their motivation, attitude, and self-efficacy toward learning chemistry. While chemistry is an important subject to learn, students do not necessarily see its relevance to real life situations. They also noted that at the centre of their sources of motivation is the teacher who, in some cases, does very little to enhance students' motivation with their choice of teaching strategies. In addition, students' desire for more practical work in chemistry lessons instead of the chalk and talk strategy used by chemistry teachers, might enhance effective learning of chemistry.

In this study, teachers' perceptions of students' motivation, attitude and self-efficacy were not sought. On reflection, it may have been beneficial to assess teachers' feedback in order to gain insights into teachers' impressions of their students' motivation, attitude, and self-efficacy toward learning chemistry. This gives rise to potential further investigations where chemistry teachers' perceptions could be acquired to consider both student and teacher behaviour. Data analysis can then be conducted on teachers' feedback, and recommendations forwarded to assist both teachers and students to acquire a better understanding about each other, and the chemistry learning environment.

Further research could be done on accessing students using quantitative means to substantiate the claims obtained qualitatively. By doing so, evidence of statistical correlations between student motivation, attitude and self-efficacy toward learning chemistry could be made. It would also be useful to determine whether high achieving chemistry students view their motivation, attitude, and self-efficacy differently from average students. It would also be interesting to further the study by considering gender influence. That is, how differently do female and male students see their motivation, attitude and self-efficacy toward chemistry with different male or female chemistry teachers. In addition, it would be interesting to conduct similar research into Years 12 and 13 chemistry students to see why students choose to continue studying chemistry at such a level, and investigate their motivation, attitude and self-efficacy toward learning chemistry.

5.6 Concluding Thoughts

It is anticipated that the findings in this thesis will create interest into further research on student motivation, attitude, and self-efficacy toward learning chemistry. The findings were obtained with the aid of an important and valuable instrument, the SMASEC. This research proved to be valuable, particularly because it is the first of its kind conducted within the context of Solomon Islands, and it allowed for teachers of chemistry to reflect, and to take stock of their teaching. Its findings also help in finding ways to improve teaching and learning weakness. It is essential that teachers of chemistry communicate the knowledge within the field effectively and adapt to changes to the learning needs of students. As is identified by the research findings, by implementing changes that foster effective and worthwhile learning of chemistry within the classroom, chemistry students' motivation would improve which, in turn, should boost student attitude and increase student sense of self-efficacy toward learning chemistry in Year 10 chemistry.

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APPENDICES

APPENDIX A. Participants Information Sheet

Project Title

An Exploration of Year (10) Students' Motivation, Attitude and Self-Efficacy Toward Learning Chemistry

Purpose

This research is conducted as partial requirement for *the Masters of Science in Technology and Science Education.* This project requires the researcher to choose a research topic and conduct research on the topic through using surveys or interviews or a combination of the two techniques.

What is this research project about?

The aim of this research is to uncover some of the underlying reasons students provide as evidence of Year 10 students motivation, attitude and self efficacy (i.e. students' ability to do a specific task) towards learning chemistry. This can then be used to help understand the nature of learner centre chemistry learning. The intention here is to provide insights into alternative ways of teaching and learning chemistry that might motivate, change students' attitude, and increase their learning confidence.

What will students be asked to do and how long will it take?

The researcher wants students in one class to complete a survey questionnaire and may have them interviewed. This should take no longer than *40 minutes*. The interview may be recorded. The students will be asked to give consent prior to the interview, and maybe asked to also give consent at a later stage.

What will happen to the information collected?

The information collected will be used by the researcher to write a research thesis for the credit of STER594-11C – A Master in Science Thesis paper. It is possible that articles and presentations may be the outcome of the research. Only the researcher *and supervisor (if applicable)* will be privy to the notes, documents, recordings and the paper written. Afterwards, notes, documents will be destroyed and recordings erased. The researcher will keep transcriptions of the recordings and a copy of the paper but will treat them with the strictest confidentiality. No participants will be named in the publications and every effort will be made to disguise their identity.

Declaration to participants

Participation in this project is voluntary. If you do choose to take part in the study, you have the right to:

- Refuse to answer any particular question, and to withdraw from the study before the data analysis has commenced.
- Ask any further questions about the study that occurs to you during your participation.
- Be given access to a summary of findings from the study when it is concluded.

Who's responsible?

If you have any questions or concerns about the project, either now or in the future, please feel free to contact either:

Researcher's name and contact details

Name: *Andrew Ita Misitomu* Department: *Centre of Science and Technology Education Research (CSTER)* Room: *KP.G.22* Phone: *+ 64 (07) 027 9165537*

Email address: *am194@waikato.ac.nz*

Supervisor's name and contact information

Name: *Professor Richard. K. Coll* Room: *KP.G.19 / B.G.02*

Email address: *RCOLL@waikato.ac.nz* Phone: *+64 (07) 838 4100*

APPENDIX B. Letter to MEHRD

89A Aurora Terrace
Hillcrest
Hamilton 3216
New Zealand

Date: 1st September 2011

To: Permanent Secretary – Mr. Charles Viva
Ministry of Education Human Resources and Development
P O Box G28
Honiara, Solomon Islands

Dear Sir,

Subject: Notification of Research

I am currently enrolled in the Master of Science Program majoring in Science and Technological Education at the University of Waikato, Hamilton, New Zealand. My thesis topic is *An Exploration of Year 10 Students Motivation, Attitude and Self-Efficacy Toward Learning Chemistry.*

I hereby would like to submit this official letter of notification to your office in regards to my research to be conducted in Honiara Secondary schools within the period of October to November 2011. The research will be conducted in secondary schools within and around Honiara City.

The focus of my research entails examining students' motivation, attitude and self-efficacy towards learning chemistry. The study will endeavour to identify the kind of motivation and attitude students have in learning chemistry, and their self-beliefs of how they learn chemistry. Data collection will be done in two parts; part one includes a survey self completion questionnaire (15 -30 mins) and part two will be a focus group interview (20 - 40mins). Please be assured that the data collected is confidential and is to be used in the construction of my thesis.

Respective Education Authorities, the School Principals concerned and research participants will all be informed on this research undertaking. This research will adhere to the University of Waikato Human Research Ethics Regulations (2008). In this research, the participants' inputs will be respected and termed as confidential. They will be informed on the outset about the ethical issues surrounding the research and their personal well being. Such ethical issues include their right to decline and withdraw from participating if they do not wish to continue in the study. Pseudonyms will be used instead for names of the schools and participants. Informed consent will be sought from the schools and the potential participants. Schools will receive a summary of the findings after the study has been completed.

I hope this is sufficient for your purpose and I thank you so much for acknowledging this notification letter.

Yours Sincerely

Mr. Andrew I. Misitom

Cc: Director Secondary Division MHRD

Cc: Education Secretary – Church of Melanesia (COM) Education Authority

Cc: Education Secretary – Catholic Education Authority (CEA)

Cc: Education Secretary – South Seas Evangelical Church (SSEC) Education Authority

Cc: Education Secretary – Honiara City Council (HCC) Education Authority

APPENDIX C. Letter to Schools

89A Aurora Terrace
Hillcrest
Hamilton 3216
New Zealand

Date: 1st September 2011

Principal
XXX
Honiara, Solomon Islands

Dear Sir,

Subject: Seeking Permission to Conduct a Research

I am currently enrolled in the Master of Science Program majoring in Science and Technological Education at the University of Waikato, Hamilton, New Zealand. My thesis topic is *An Exploration of Year 10 Students Motivation, Attitude and Self-Efficacy Toward Learning Chemistry.*

I am writing to seek your permission to include the Year 10 classes of your school in my research. I envisage that all science students in Year 10 would complete a questionnaire to assist in my quantitative research. At a later stage, I would like to interview a small number of students for the qualitative analysis section of my thesis. I do stress that the School, the students and the staff will not be identified in this research.

The questionnaire would take no longer than 30 minutes to complete and the interview no longer than 40 mins and there would be minimal interruption to the school academic program on that day. Firstly, the questionnaire on *Students Motivation, Attitude and Self-Efficacy in Chemistry* (SMASEC) examines how students respond to learning chemistry and what enhances their level of motivation, attitude and self-efficacy. I have included the questionnaire for your perusal. I believe that my research to be most valuable in identifying effective classroom chemistry teaching and learning and the type of interpersonal behaviour students have that enhance a positive classroom environment. I see that student involvement in my research to be an avenue by which they can reflect on their own classroom climate. At the completion of my study, I will forward you an overview of my results.

I look forward to your support. Could you please advise me of you decision regarding my research at your earliest convenience. Ideally, I would like to administer the questionnaire during week 3 in Term 4, 2011.

Yours faithfully

Mr. Andrew I. Misitomu

APPENDIX D. Principals Consent Form

I have read the attached letter of information.

I understand that:

1. My school's/staff member's and his/her students participation in the project is voluntary.
2. I have the right to withdraw my school/staff member and his/her students from the research at any time.
3. Data may be collected from my school/staff member and his/her students in the ways specified in the accompanying letter. This data will be kept confidential and securely stored.
4. Data obtained during the research project will be used for the purpose of writing reports, published papers and making presentations. This data will be reported without use of names of participants or their organizations.
5. I can direct any questions to Andrew I. Misitom

Researcher's name and contact details

Name: *Andrew Ita Misitomu*
Department: *Centre of Science and Technology Education Research (CSTER)*
Room: *KP.G.22* Phone: *+ 64 (07) 027 9165537*
Email address: *am194@waikato.ac.nz*

For any unresolved issues I can contact the Supervisor.

Supervisor's name and contact information

Name: *Professor Richard. K. Coll* Room: *KP.G.19 / B.G.02*

Email address: *RCOLL@waikato.ac.nz* Phone: *+64 (07) 838 4100*

I give consent for my school/staff member and his/her students to be involved in the project under the conditions set out above.

Name: ___________________________

Signed: __________________________

Date: ____________________________

APPENDIX E. Students' Motivation, Attitude and Self-Efficacy Toward Learning Chemistry Questionnaire (SMASEC)

<u>Students' Motivation, Attitude and Self-Efficacy</u>
<u>Toward Learning Chemistry</u>

Items 1 – 32 below consist of a number of statements about Chemistry and Chemistry lessons you might have in this class.

You will be asked what you think about these statements.

There are no 'wrong' or 'right' answers. Your opinion is what is wanted.

For **each** statement, place a tick in the appropriate box. If you want to change your answer, cross it out and place a tick in a new box (See example below). I would appreciate if you answer every question.

1 if you **STRONGLY AGREE** with the statement

2 if you **AGREE** with the statement

3 if you **NEITHER AGREE NOR DISAGREE** with the statement

4 if you **DISAGREE** with the statement

5 if you **STRONGLY DISAGREE** with the statement

For example:

E. ATTITUDE TOWARDS CHEMISTRY		**Strongly Agree (1)**	**Agree (2)**	**Neither Agree nor Disagree (3)**	**Disagree (4)**	**Strongly Disagree (5)**
1.	**Chemistry Lessons are fun**	✓				✗

Please complete the following details below before commencing the questionnaire.

Student name: ______________________________

School: ______________________________

Grade: ______________________________

Teacher: ______________________________

SCALES						
A. CHEMISTRY LEARNING VALUE		**Strongly Agree (1)**	**Agree (2)**	**Neither Agree nor Disagree (3)**	**Disagree (4)**	**Strongly Disagree (5)**
1.	I think that learning chemistry is important because I use it in my daily life.					
2.	I think that learning chemistry is important because it stimulates my thinking.					
3.	In chemistry I think that it is important to learn to solve problems					
4.	In chemistry, I think it is important to participate in experimental activities.					
5.	It is important to have the opportunity to satisfy one's own curiosity when learning chemistry.					
B. PERFORMANCE GOAL		**Strongly Agree (1)**	**Agree (2)**	**Neither Agree nor Disagree (3)**	**Disagree (4)**	**Strongly Disagree (5)**
6.	I do chemistry courses to get a good grade.					
7.	I do chemistry to perform better than other students.					
8.	I do chemistry courses so that other students think that I'm smart.					

9.	I do chemistry courses so that the teacher pays attention to me.					
C. ACHIEVEMENT GOAL		**Strongly Agree (1)**	**Agree (2)**	**Neither Agree nor Disagree (3)**	**Disagree (4)**	**Strongly Disagree (5)**
10.	During a chemistry course, I feel I really achieved my goal when I get a good score in a test.					
11.	During a chemistry course, I feel I really achieved my goal when I gain confidence with the content.					
12.	During a chemistry course, I feel I really achieved my goal when I am able to solve a difficult problem.					
13.	During chemistry course I feel I really achieved my goal when the teacher accepts my ideas.					
14.	During a chemistry course, I feel I really achieved my goal when other students accept my ideas.					
D. ATTITUDE TOWARDS CHEMISTRY						
15.	I look forward to chemistry lessons.					
16.	Chemistry lessons are fun.					
17.	I enjoy the activities we do in chemistry.					
18.	What we do in chemistry are among the most interesting things we do at school.					
19.	I want to find out more about the world in which we live					
20.	Finding out about new things is important.					
21.	I enjoy chemistry lessons in this class.					

22.	I like talking to my friends about what we do in chemistry.					
23.	We should have more chemistry lessons each week.					
24.	I feel satisfied after a chemistry lesson.					
E. SELF-EFFICACY		**Strongly Agree (1)**	**Agree (2)**	**Neither Agree nor Disagree (3)**	**Disagree (4)**	**Strongly Disagree (5)**
25.	I find it easy to get good grades in chemistry.					
26.	I am good at this subject.					
27.	My friends ask me for help in this subject.					
28.	I find chemistry easy.					
29.	I perform better than most of my classmates in chemistry.					
30.	I have to work hard to pass chemistry.					
31.	I am an intelligent student.					
32.	I help my friends with their homework in chemistry.					

APPENDIX F. Semi-Structured Interview Guiding Questions

- **Introduction**

  1. What do you understand about the term chemistry?

- **Valuing learning Chemistry**

  2. How important is learning chemistry to you?
  3. How motivated are you in studying chemistry?

- **Performance Goal**

  4. What is your reason for studying chemistry?

- **Achievement Goals**

  5. How do you know that you have achieved your goal in studying chemistry?

- **Attitude Towards Chemistry**

  6. What do you like/dislike about studying chemistry?

- **Self-Efficacy**

  7. Do you think you are good in chemistry?